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IDENTIFIERS Acidosis; Alkalosis; Asepsis; Blood; Blood Transfusion; Digestive System; Epidemiology; *Health Instruction Exchange; Nerve Impulses

ABSTRACT

Text, illustrations, and exercises are utilized in a set of nine learning modules designed to instruct nursing and allied health students in a variety of biological topics. The first module, by Barbara Cathey, discusses cell growth and the proliferation of cells in benign and malignant tumors. The second module, by Eugene Volz, describes the functions of the various types of white blood cells and explains how to identify them under the microscope. The third module, by Oliver H. Duggins, investigates the basic types of neurons and the physiology of a nerve impulse. The fourth module, by Leland Van Fossen, details the functions of the organs along the digestive tract. The fifth module, by Reba Douglass Grubb, identifies the sequential events in the development and transmission of infectious disease. The sixth module, by S. W. Lavinger, describes the parts of flowering plants and the conditions necessary for their growth and development. The seventh module, by Barbara L. Turk, introduces the basic principles of medical and surgical asepsis. The eighth module, by A. Louise Jones, describes the varying presence of antigens and antibodies in differing blood types and examines the types of blood that recipients can receive from donors. The ninth module, by Betty K. Grayson, explains the use of blood pH levels and arterial blood gas values in diagnosing respiratory and metabolic acidosis and alkalosis. Each module provides reinforcement exercises and a post-test. (JP)

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HEALTH INSTRUCTION PACKAGES:

BASIC SCIENCES

Modules prepared by:

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Oliver H. Duggins, Ph. D.
Leland Van Fossen
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JC 810 325

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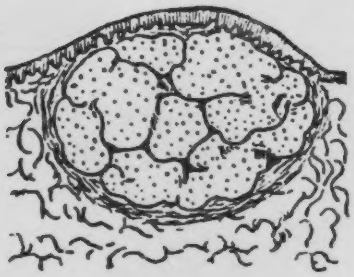
INTRODUCTION TO CELL PROLIFERATION

By

Barbara Cathey



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TITLE OF PACKAGE: Introduction to Cell Proliferation

AUTHOR: Barbara Cathey

INSTITUTION: El Centro College, Dallas, Tex.

INTENDED STUDENTS: Nursing

ESTIMATED WORKING TIME: 30 minutes

MATERIALS NEEDED: None

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OBJECTIVES OF UNIT

Overall Objective

The student nurse, upon completion of the packet, will be able to recognize basic information relating to cell proliferation.

Sub-Objectives

1. Recognize description of normal cell growth.
2. Recognize abnormal cell growth.
3. Define the terms relating to neoplasms.
4. List examples of benign neoplasms.
5. List examples of malignant neoplasms.
6. Identify the characteristics of benign neoplasms.
7. Identify the characteristics of malignant neoplasms.
8. State willingness to seek more information concerning cell proliferation.

INTRODUCTION

Probably the most dreaded word in the medical profession today is Cancer. It ranks #2 to heart disease. It's a killer, a maimer, a disfiguring horror. There are some truths in these perceptions. There are also some more concrete, optimistic truths. Today, about one patient in three with cancer is being saved. A few years ago, the ratio was 1:4. This represents a gain in lives of about 45,000 people per year. Just by applying what we know about cancer today, we could save fully one-half of those with cancer. New developments in detection and treatment have caused these advances, and cancer research is opening up new cures daily.

For many reasons, the nurse can make significant contributions to the patient with cancer. This situation requires that she possess more knowledge and skill than in almost any other one. Even the patient with other diagnoses possesses a fear of cancer. Nurses must accept cancer as a disease similar to many others in that it can sometimes be prevented and cured. Patients with cancer are from all ages and social groups, and nursing plays a role in detection and prevention programs. Nurses also must provide emotional support to patients and families who face the threat of cancer.

Now, begin your learning adventure into Introduction to Cell Proliferation.

PRACTICE EXERCISE #1

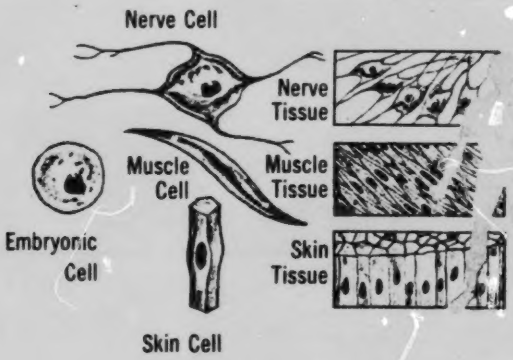
Input

Normal cell growth follows certain principles:

- It is necessary for the maintenance of the life of the organism.
- Normal growing cells are similar in physical structure and in function.
- The cells form themselves in an orderly manner into well defined tissues and organs.
- Normal growth is subject to influences which cause cell division to cease when its purpose has been achieved.

Practice Question #1

Define normal cell growth.

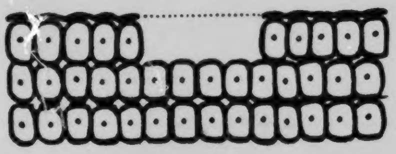

Nerve Cell
Nerve Tissue
Muscle Cell
Muscle Tissue
Embryonic Cell
Skin Tissue
Skin Cell

Practice Exercise #1 (cont.)

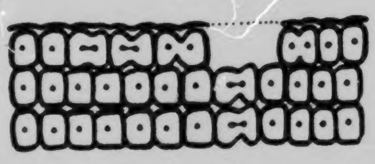
Feedback

Normal: multiplication occurs in response to a stimulus; is adequate to meet the needs of the organism; differentiates into normal mature tissue. Ceases production when needs are met like wound healing - seen in picture below.

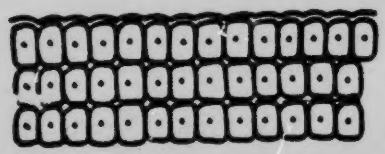
NORMAL GROWTH
IN THE REPAIR AND
REPLACEMENT
OF BODY TISSUE



1. Normal tissue, showing injury



2. Cells divide to start orderly repair



Proceed to next page....

PRACTICE EXERCISE #2

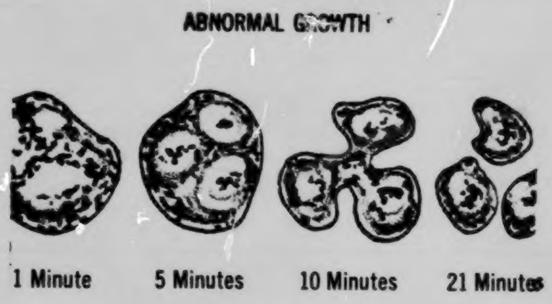
Input

Abnormal cell growth:

Group of living cells which, for reasons not yet fully understood, begin to grow and reproduce without the usual controls. Cell multiplication rate is changed - one cell may become three, or four or more; cells are irregular in size and shape; they no longer form useful tissues or organs, and they do not stop multiplying. Sometimes the number of chromosomes is ↑ or ↓ or the chromosomes are broken up. Sometimes the chromosomes divide but the cell does not, resulting in a doubled or even in a quadrupled number of chromosomes. Masses of the cells sooner or later result in a lump or swelling which is called a tumor.

Practice Question #2

Define abnormal cell growth.



Good.....next page

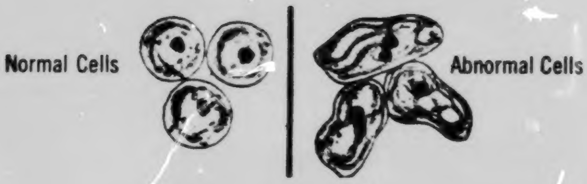
PRACTICE EXERCISE #2 (cont.)

Feedback

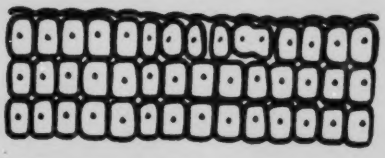
Abnormal: Cell production responds to inappropriate stimulus; is inadequate to or in excess of the needs of the organism; results in immature or abnormal cells; continues growing without regard for the needs of the organism.

THE ABNORMAL
GROWTH
OF CANCER

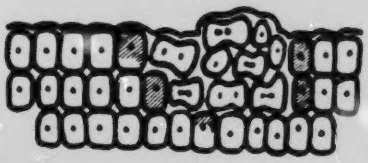
See



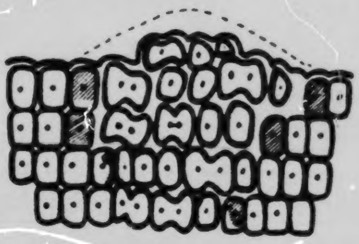
Now - Do you see the difference?



1. A cancerous growth begins



2. Disorderly multiplication of cancer cells



3. The spread of cancer through normal tissue
When a blood or lymph vessel is invaded, cancer cells may move to other parts of the body and start secondary cancerous growths.

PRACTICE EXERCISE #3

Input

A mass of cells which show little deviation from normal and only limited penetration into the surrounding area and do not spread to other areas is called benign tumor because it usually does not endanger life. Examples of this kind of tumor are warts and moles.

Practice Question #3

Define benign tumor and give an example.

Practice Exercise #3 (cont.)

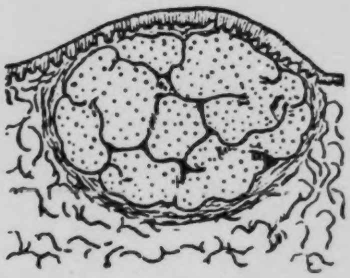
Feedback

Benign tumor:

a neoplasm that is not deadly by itself. But it may be a threat because of the location, like a brain tumor.

Examples: Wart; mole

Encapsulated Benign Tumor

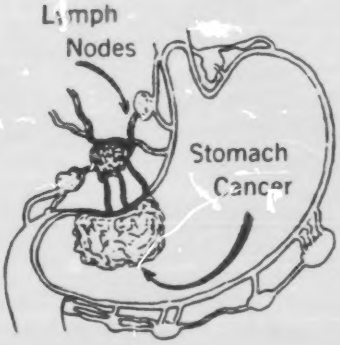


Very Good!........

PRACTICE EXERCISE #4

Input

A growth of cells; abnormal in structure and behavior, which penetrates and spreads, is a malignant tumor, one that will almost certainly cause death if it is not removed or destroyed. This is cancer: a disorderly and uncontrolled growth of the cells of the body which do not stop multiplying once they begin.

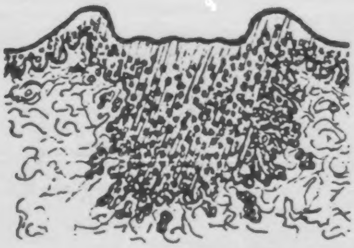


Example of stomach cancer

Types

1. Carcinoma: malignant neoplasms arising in soft tissue - ectoderm or endoderm.
2. Sarcoma: malignant neoplasm arising in connective tissue - mesoderm.

Malignant Growth

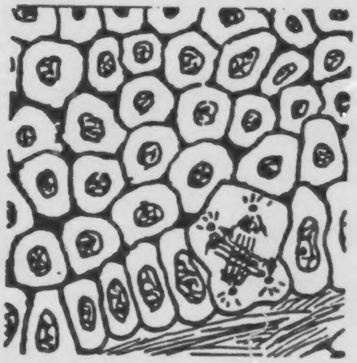


PRACTICE EXERCISE #4 (cont.)

Practice Question

What is a malignant tumor?

Give an example.



Feedback

Malignant tumor: Cancer is used synonymously with malignant neoplasm. The word malignant comes from the Latin word for evil - neoplasms in which death is probable if the malignancy is left untreated.

Input

When a student prepares for a study of tumors or cell proliferation, there are basic terms that are important. Look the difinitions up in your medical dictionary.

Cancer

Benign

Sarcoma

Mitosis

Tumor

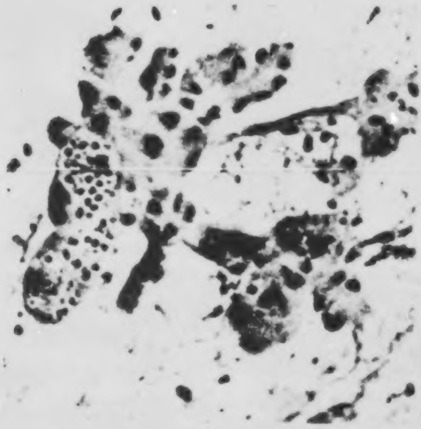
Malignant

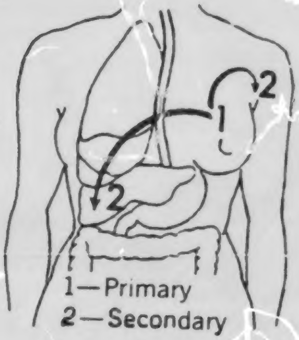
Neoplasm

Oncology

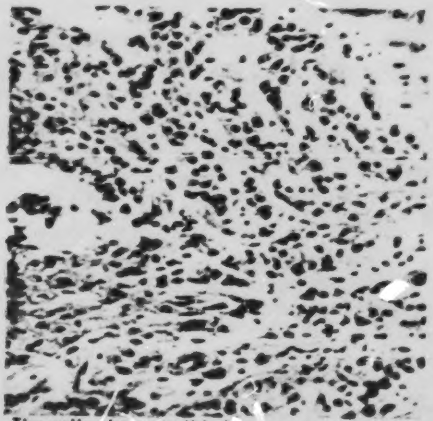
Metastasis

Lymph





This Pap smear from the cervix shows both normal and cancerous cells. The cells at the right and in the center are normal while those to the left center and lower portion of the center are malignant cells.



The cells shown in this biopsy, taken from the gums, are very malignant. Notice the wild growth; the irregular shape and size.

Practice Question 5

Do you know meaning of above terms?

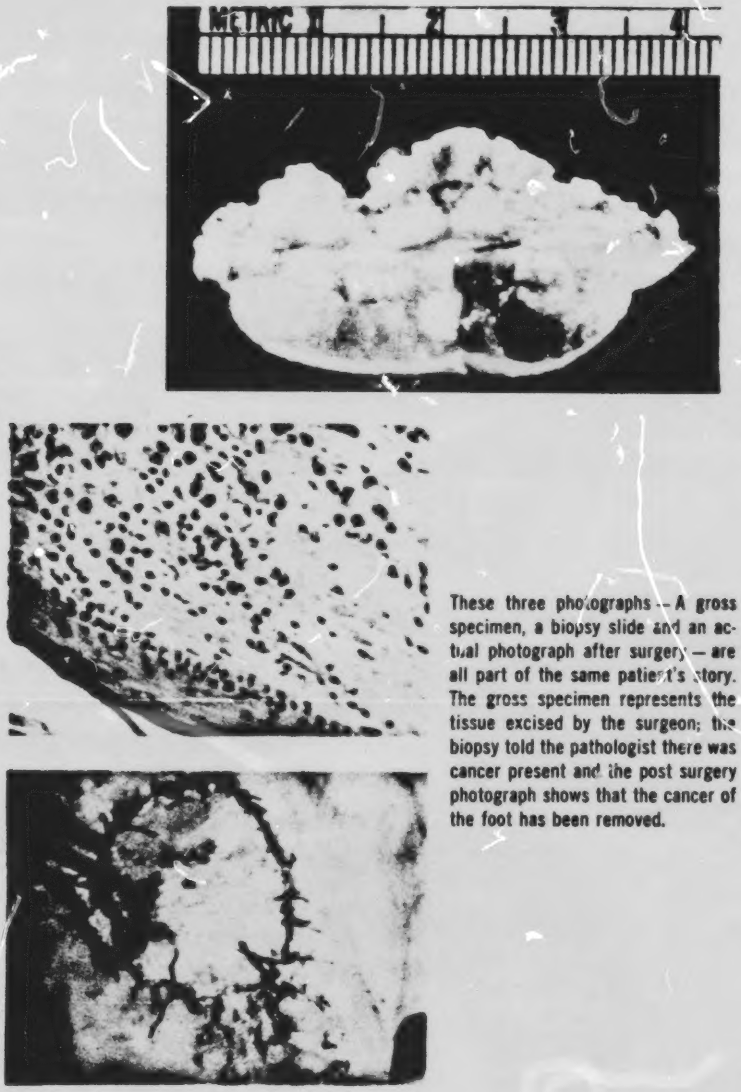
Please define them in your own words.

Turn...........

Feedback

TUMOR	An abnormal swelling or enlargement made up of a mass of cells which grow as an independent mass and serve no useful purpose.
BENIGN TUMOR	An abnormal growth which does not spread to other parts of the body and which does no particular harm unless it happens to press upon a vital organ.
MITOSIS	Typical mode of division of active cells.
NEOPLASM	Any abnormal growth - a tumor.
METASTASIS	A secondary growth of cancer cells formed in some body area away from an original cancer.
LYMPH	A clear body fluid found outside the blood vessels closely resembling blood plasma.
CARCINOMA	A malignant tumor or cancer.
MALIGNANT TUMOR	"Harmful growth" - cancer.
CANCER	An abnormal growth with a tendency to spread within the body which, if untreated, will result in death.
SARCOMA	Malignant neoplasm arising in connective tissue - mesoderm.
ONCOLOGY	Study of tumors.

WOULD YOU BE INTERESTED IN LEARNING MORE CONCERNING THIS TOPIC?



These three photographs -- A gross specimen, a biopsy slide and an actual photograph after surgery — are all part of the same patient's story. The gross specimen represents the tissue excised by the surgeon; the biopsy told the pathologist there was cancer present and the post surgery photograph shows that the cancer of the foot has been removed.

POST-TEST

1. Match the following terms:

A. Neoplasm

B. Malignant

C. Benign

1) Cell in which the basic structure and activity have become deranged in a manner that is unknown

2) Any abnormal growth - a tumor.

3) An abnormal growth which does not spread to other parts of the body and which does no harm unless it happens to press on vital organ.

2. Rapid and disorderly division of cells is a characteristic of normal cell growth.

T _ F

3. Define normal cell growth.

4. Define abnormal cell growth.

5. List four characteristics of benign tumors:

1)

2)

3)

4)

6. List three characteristics of malignant tumors:

1)

2)

3)

7. Give an example of benign tumors.

8. Give an example of malignant tumor.

POST-TEST (cont.)

9. Match the following terms:

_____ 1 Neoplasm

_____ 2 Tumor

_____ 3 Benign

_____ 4 Malignant

_____ 5 Cancer

_____ 6 Carcinoma

_____ 7 Sarcoma

_____ 8 Oncology

A. Study of tumors

B. Malignant neoplasms arising in connective tissue - mesoderm.

C. Malignant neoplasms arising in soft tissue-ectoderm or endoderm.

D. Used synonymously with malignant neoplasms.

E. From Latin word for evil. Neoplasms in which death is probable, if left untreated.

F. Neoplasm that is not deadly in itself, but may be a threat because of its location.

G. Used interchangeably with neoplasm.

H. New growth - may be a loss or a gain in cells.

10. Would you be interested in the next two weeks pursuing this topic further?

KEY TO POST-TEST

1. A - 2
   B - 1
   C - 3

2. F

3. Refer to Practice Question #1

4. Refer to Practice Question #2

5. (1) Show little deviation from normal cells
   (2) Limited penetration into surrounding area
   (3) Do not spread
   (4) Usually does not endanger life

6. (1) Cells are immature and abnormal in appearance and organization.
   (2) Abnormal mitotic activity
   (3) Metastasizes to surrounding tissue; via blood and lymph system.

7. Wart or mole

8. Carcinoma
   Sarcoma

9. 1) H
   2) G
   3) F
   4) E
   5) D
   6) C
   7) B
   8) A

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THE WHITE BLOOD CELLS:
IDENTIFICATION AND FUNCTION

By

Eugene Volz

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TITLE OF PACKAGE:	The White Blood Cells: Identification and Function
AUTHOR:	Eugene Volz
INSTITUTION:	Sacramento (Calif.) City College
INTENDED STUDENTS:	Allied health
ESTIMATED WORKING TIME:	60 minutes
MATERIALS NEEDED:	Microscope with intermediate and high-dry objectives; Wright stained blood smear

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OBJECTIVES

1. Name five basic items conveyed by the blood.

2. Identify granular and agranular leucocytes by name, frequency, size, and stained appearance.

3 Identify the functions and sites of production of the neutrophils, monocytes, lymphocytes, eosinophils and basophils.

4. Describe platelets, their function and site of production.

5. In the laboratory, identify the various white cells on a stained slide.

Practice Exercise #1

Input:

As you probably already know, blood is a complex mixture which basically serves to convey nutrients, waste products, hormones, heat, and respiratory gases around the body. It is essentially composed of two parts: (1)plasma, the liquid vehicle and (2)cells, including the red cells(erythrocytes) and white cells (leucocytes). This program is concerned with the white blood cells and by successfully completing it you will be able to identify each of the various white cells, learn the functions, as far as are know, for each of these, and their origins in the body.

You should complete practice exercises 1 through 8 before coming to laboratory. This way you will be able to most effectively utilize your valuable laboratory time. I would suggest that you utilize your textbook as an additional reference. For example, the various cellular components of the blood are illustrated on p.375 of Langley, Telford and Christensen, "Dynamic Anatomy and Physiology".

Practice Examination #1

1. Name the components of the blood.
2. Name five basic items conveyed by the blood

a)____________________________

b)____________________________

c)____________________________

d)____________________________

e)____________________________

Practice Exercise #1

Feedback #1

Sure, blood is composed of cells and plasma. Can you remember what kind of cells? If you can't, they are listed at the bottom of the page.

And the five basic conveyance functions of the blood involved transport of ...

a. heat

b. hormones

c. respiratory gases

d. nutrients

e. waste products

Erythrocytes and leucocytes

Practice Exercise #2

Input:

White blood cells (WBC's, leucocytes) can be described as belonging to two classes, based on the routinely-used staining procedures. These are "granular" leucocytes, or granulocytes, and "agranular" leucocytes or agranulocytes. All leucocytes contain a nucleus; the granules referred to, or implied, by the names are seen in the cytoplasm of these fixed and stained cells, and are not visible in living, unstained preparations of the blood. Thus cells possessing granules are granulocytes and those lacking granules are agranulocytes. The varieties of cells of the granular series are as follows:

- Granulocytes
    - Neutrophils (Polymorphonuclear leucocytes=Polys)
    - Eosinophils (Acidophils)
    - Basophils

The names of the specific granulocytes refer to the staining tendencies of the granules in the cytoplasm of the cells, thus the neutrophils ("neutral loving") have granules which do not stain well at all appearing as pale lilac and not at all obvious. The name "polymorphonuclear", refers to the large, multi-lobed nucleus of these cells and hence are often clinically referred to as "polys" for short. 65 to 75 percent of the circulating leucocytes (not just granulocytes, but all white blood cells) are neutrophils.

Eosinophils have brilliant red granules, the red color due to the dye "eosin" which is used to color the antiseptic, merthiolate. Since the dye favors acidic features, these cells are also termed acidophils. They constitute 2 to 5% of the circulating leucocytes.

Basophil granules stain with basic dyes, hence the granules are an intense blue-purple color. They number only about 0.5%, and are therefore rarely seen.

Practice Exercise #2

Practice Examination #2

1. Which of these granulocytes is the least common?

    a. leucocyte

    b. eosinophil

    c. acidophil

    d. basophil

    e. poly

2. Which of these granulocytes has bright red granules?

    a. basophil

    b. acidophil

    c. neutrophil

    d. poly

    e. none of these

3. What is another name for leucocyte?

    a. poly

    b. eosinophil

    c. basophil

    d. white blood cell

    e. granulocyte

4. The granules in granulocytes are easily seen in the living cell.

    a. True

    b. False

Practice Exercise #2

Feedback #2

1. That's right "d". Basophils represent only ½ percent of the total circulating WBC's.
2. The acidophils (b) stain with the acidic dye "eosin" which gives the bright red color to the antiseptic, merthiolate. Hence they are called "eosinophils".
3. Leucocytes are, as you said, white blood cells (d). Granulocytes are those leucocytes with granules and the others listed are simply varieties of granulocytes.
4. The answer is false. In the first paragraph we defined granulocytes as those cells containing granules which stain differentially.

Practice Exercise #3

Input:

As we have just learned there are three kinds of granular leucocytes, neutrophils, eosinophils and basophils. In addition, there are two varieties of white cells, belonging to the agranular series, which lack granules in stained preparations:

Agranulocytes
   Lymphocytes
   Monocytes

Lymphocytes are the second most abundant white cell variety (neutrophils are the most abundant) constituting 25 to 30% of the circulating WBC's.

Monocytes are the largest white cell variety and can frequently be distinguished by size alone. Monocytes number about 3 to 8% of the total circulating leucocytes.

White cell numbers vary considerably according to the state of health of the individual. The usual value is around 7,000 per cubic millimeter.

Practice Examination #3

1. Encircle the letters corresponding to the agranular leucocytes from the following list.

   a. lymphocytes b. leucocytes c. acidophils d. neutrophils
   e. monocytes

2. Which white cell variety constitutes 25 to 30% of the circulating leucocytes?

   a. monocytes b. lymphocytes c. acidophils d. neutrophils
   e. basophils

3. Which of these is the largest white cell?

   a. monocyte b. lymphocyte c. acidophil d. neutrophil
   e. basophil

Practice Exercise #3

Feedback #3

1. Sure, the agranular leucocytes are lymphocytes (a) and monocytes (e). Some leucocytes are agranular, but that does not answer the specific question.
2. Lymphocytes (b) constitute the second most abudant group of WBC's, and represent 25 to 30% of the total.
3. The "big mama" of the leucocyte world is the monocyte (a). They are not abundant, but they are big.

Practice Exercise #4

Input:

The functions of the leucocytes

Phagocytosis, cellular eating, is the principal and most widely-known activity of the white cells. This activity is characteristic of the neutrophils and monocytes. Once bacteria enter the protective envelope of the skin and start the infectious process, histamine is released by the irritated cells and toxic substances are given off by the bacteria. Blood vessel dilation occurs as a result and the neutrophils and monocytes are attracted to the area and stick to the walls of the capillaries in the infected tissue. The attraction of cells by chemical means is termed chemotaxis. Histamine increases the permeability of these capillaries and these phagocytic cells squeeze across the capillary wall and enter the surrounding tissue spaces, where in the bacteria reside. This movement across the capillary wall is called diapedesis. These cells now engulf bacteria and lysosomes within the cells rupture, resulting in the death of the bacteria and ultimately the death of the neutrophil or monocyte. Local tissues die also and the mix of dead leucocytes, dead tissue cells and live and dead bacteria constitute what is known as "pus". This material chemotactically attracts still more phagocytes.

Practice Examination #4

1. The leucocytes specifically involved in phagocytosis are ...
    - a. neutrophils
    - b. basophils
    - c. monocytes
    - d. eosinophils
    - e. lymphocytes

Practice Exercise #4

Practice Examination #4

2. What is the action of histamine in relation to the phagocytic white cells?
    a. Histamine acts as an agent which stimulates the aggregation of the phagocytic cells
    b. Histamine is a lysing enzyme causing the destruction of the white cells
    c. Histamine is a principal component of pus
    d. Histamine increases the permeability of the capillary walls, making diapedesis possible
    e. Histamine is one of the chemicals providing the protective envelope of the body

3. What is chemotaxis?
    a. The movement of white cells across the capillary wall
    b. The formation of pus
    c. The attraction of cells by a chemical substance
    d. Cars for hire which carry chemicals
    e. Government levy on chemicals

Practice Exercise #4

Feedback #4

1. You remembered. The leucocytes involved in phagocytosis are the neutrophils and monocytes (a and c).
2. Histamine is a chemical released by damaged cells and is involved in vasodilation and increasing the permeability of capillaries. So the answer is (d).
3. Sure the answer is c. D and e are merely jokes, I hope you realize. So they're not very funny; but it's hard to get humor out of pus!

Practice Exercise #5

Ready to learn more? You ought to be wondering what the functions of the other 3 leucocytes are. Can you remember their names? Write them down here:

____

____

____

Check your answers on the next page.

Practice Exercise #5

(Input: continued)

That's right: lymphocytes, eosinophils and basophils.

The functions of lymphocytes are complex. For one thing, they seem to be multipotential; some authors thus believe that they can transform or be changed into other needed blood cell varieties. They are suspected of even being able to enter the red bone marrow and being converted into red blood cells. They can change into monocytes and become, thereby, phagocytic. They can also behave like antibodies. Antibodies are chemical substances, called gamma globulin, manufactured by the body in response to the presence in the body of a specific foreign substance, called an antigen. This antibody then can destroy, inactivate or otherwise make this foreign substance harmless. This process is, of course, what is involved in vaccinations. The vaccine is a harmless, but antigenically active, substance which triggers the body's antibody synthesizing systems. With this antibody now, so to speak, programmed, the arrival of a now disease-producing organism with the same antigenic properties as the vaccine, causes the body's antibodies against that specific antigen to be produced in great numbers and the organism is destroyed. The body triumphs (a drum roll and trumpet fanfare!) and our vaccinated individual not only does not die, but does not even become ill.

Well, it seems that lymphocytes may also act like gamma globulin. Like the chemical, these cells attach to the foreign material and start to destroy (by lysis) it. This is the basic process in graft rejection, as for example, transplanted hearts. Medically, transplant recipients are given ALS (antilymphocytic serum) to prevent the graft from being recognized as being foreign.

That's quite a bit of input, so let's find out what you have learned.

Practice Exercise #5

Practice Examination #5

1. A foreign protein can be called ...

   A. a lymphocyte b. an antibody c. a gamma globulin

   d. an antigen e. a phagocyte

2. Chemical antibodies are generally ...

   a. lymphocytes b. antilymphocytic serum c. gamma globulin

   d. vaccines e. antigens

3. What is introduced into the body when you are vaccinated?

   a. a specific gamma globulin

   b. an antigen

   c. antilymphocytic serum

   d. lymphocytes

   e. none of the above

4. Mark all the spaces below corresponding to the functions lymphocytes, as lymphocytes, have in the body.

   a. They are capable of transforming into other blood cell varieties

   b. They are capable of phagocytosis

   c. They can act as antibodies

   d. Your lymphocytes can act as antigens in your body

   e. None of the above is a function of lymphocytes

5. Why would antilymphocytic serum be used, as described in this module?

   a. To destroy excessive numbers of lymphocytes

   b. To vaccinate a person

   c. To prevent graft rejection

   d. To prevent a disease for killing

   e. None of the above

Practice Exercise #5

Feedback #5

1. Foreign proteins are known as antigens (d). These substances trigger an immune response involving antibody formation by the body. Gamma globulin is the name of the chemical which is the antibody.
2. As we said above, chemical antibodies are gamma globulin (c).
3. When you are vaccinated a relatively harmless antigen (b) is introduced which starts off the formation of antibodies.
4. Lymphocytes can change into other blood cell varieties (a) and they can act as antibodies in graft rejection (c). Lymphocytes, as lymphocytes, are not capable of phagocytosis - they can only ingest bacteria if they are transformed into monocytes.
5. Antilymphocytic serum is used if a person has received a graft from another individual. Without ALS, the lymphocytes will recognized this as an antigen, stick to it and lyse the graft. If the graft is essential to life, this generally would mean the death of the recipient, unless a new graft can be immediately implanted.

Practice Exercise #6

Input:

We have two more leucocytes to discuss: eosinophils and basophils. Very little is known about the functions of these two granulocytes. Eosinophils increase in the circulating blood when the body is exposed to an antigen, especially allergens, that is substances that evoke allergic responses, such as itching eyes, dripping nose or hives. Antihistamines have been shown to diminish the frequency of circulating eosinophils. They also may be responsible for producing a "profibrinolysin" which becomes converted to "fibrinolysin". Fibrinolysin is a clot-dissolver, thus clots formed in the walls of blood vessels can be gotten rid of once their usefulness is past.

Basophils can secrete the anticoagulant substance, heparin. Heparin prevents the clotting of blood in the blood stream. Basophils also release histamine, serotonin and kinins which are key substances in anaphylactic (circulatory immune reaction) shock. In staining reaction, they are like the mast cells previously studied in areolar connective tissue. In fact, some authors consider basophils to be circulating mast cells. Anaphylactic shock produces a profound drop in blood pressure which can result in the death of the victim. We will study anaphylactic shock in a bit more detail later.

Practice Examination #6

1. Mark all those spaces corresponding to the materials believed secreted by basophils.

   a. histamine b. kinins c. heparin d. melantonin e. serotonin

2. What is the action of a fibrinolysin?

   a. convert profibrinolysin
   b. increase capillary permeability
   c. prevent blood from clotting
   d. dissolve formed clots
   e. increase numbers of circulating eosinophils

Practice Exercise #6

Practice Examination #6 (Continued)

3. What change in the frequency of circulating eosinophils occurs when the body is exposed to an antigen?

   a. they increase in numbers

   b. they decrease in numbers

   c. no marked change in their frequency occurs

Practice Exercise #6

Feedback #6

1. Basophils are believed to produced heparin (c), serotonin (e), Kinins (b) and histamine (a). These substances tend to depress blood pressure in various ways which results in the anaphylactic shock reaction.
2. Fibrinolysin is a clot-dissolving substance (d) as you remembered. "Fibrin" refers to the protein which forms the clot and "lysin" refers to the lysing ability ("making a solution" of the substance).
3. Antigen exposure has been shown to increase (a) the frequency of circulating eosinophils. Antihistamines depress the numbers of these eosinophils.

Practice Exercise #7

Input:

We have one last category of formed element in the blood; these are the blood platelets. While they are not cells, they are derived from cells and represent bits or chunks of nucleus-free cytoplasm. They usually form clusters of bluish-stained blobs on slides, looking more like artifacts (debris) than something which is supposed to be in the blood. Their function is to act as storehouses of the blood-clotting enzyme "thromboplastin" (also called "thrombokinase" or Factor III). For this reason, platelets are also called "thromobocytes".

Platelets are formed in red-bone marrow from specialized cells called megakaryocytes. The name refers to the large size of its nucleus. These cells send out long cytoplasmic processes which bud off the parent cell and form these cytoplasmic clusters, which then escape into the circulating blood.

Practice Examination #7

1. Which of these best describes the platelets?
   - a. Large cells with a large, multilobed nucleus
   - b. Small cells with a large nucleus almost filling the cell
   - c. A large cell with long cytoplasmic processes and a very large nucleus
   - d. Small fragments of cells lacking a nucleus usually forming clusters in the circulating blood
   - e. Biconcave disks lacking a nucleus
2. A synonym for platelets is ...
   - a. thrombocytes b. lymphocytes c. thymocytes d. leucocytes
   - e. megakaryocytes

Practice Examination #7 (Continued)

3. Platelets are carriers of ...
    a. hemoglobin
    b. thromboplastin
    c. fibrinolysin
    d. profibrinolysin
    e. fibrin
4. Where are platelets produced?
    a. in red bone marrow
    b. in yellow bone marrow
    c. in lymph nodes
    d. in the thymus
    e. in various tissues throughout the body, as yet unknown.

Practice Exercise #7

Feedback #7

1. Platelets are fragments of cells, free of a nucleus and forming clusters in the peripheral circulation -- that is the answer, as you said, was (d).
2. Platelets are also called (a) thrombocytes since they are cells ("cytes") containing thromboplastin.
3. Platelets carry thromboplastin (b).
4. Platelets are produced in red bone marrow from cells called magakaryocytes. They are created by the pinching off of the terminal ends of the long cytoplasmic processes of the megakaryocytes.

Practice Exercise #8

Input:

We now know where platelets are produced. We might ask then, where are the other leucocytes produced? The granulocytes and monocytes develop within the red bone marrow, along with the erythrocytes. There is some controversy concerning the origins of these cells, but the evidence seems to favor the statement made here. Monocytes may also form in the liver and spleen. Cells having their origin in red marrow are spoken of as being "myeloid".

Lymphocytes arise within lymph nodes, primarily. Here again some controversy exists, especially as to whether other organs are involved in their production, notably tonsils, spleen, thymus or even red bone marrow. Lymphocytes are therefore generally considered as having a "lymphoid" origin.

However, for testing purposes in this class, we will consider the following to be correct:

Red Bone Marrow (myeloid series)	Lymph Nodes (lymphoid series)
Neutrophils	Lymphocytes
Eosinophils	
Basophils	
Monocytes	

Practice Exercise #8

Practice Examination #8

Which of the following are not produced in red bone marrow, to any significant extent? More than one answer may be possible.

a. eosinophils

b. platelets

c. neutrophils

d. lymphocytes

e. monocytes

Feedback #8

No problem: lymphocytes (d) are produced by the lymph nodes of the body; all the others, including platelets, are produced by red bone marrow.

Practice Exercise #9

Input:

Well, it looks like we are now ready to put our knowledge to some practical good. We are going to look at a stained blood smear. So get yourself a microscope and the slide "human blood smear". Focus the scope at intermediate power (10x objective) on the sample of blood.

What you see at this very slight magnification are a layer of tiny "orangish" or "pinkish" dots with scattered blue dots. The abundant pink or orange dots are red blood cells (erythrocytes). The purple dots are the nucleated leucocytes. It is these purple-blue staining cells in which we are obviously interested.

Switch to high dry (40 - 43x). Although you may be able to see individual leucocytes more clearly using oil immersion lenses which magnify 90x, the difficulty of set up and clean-up plus the much more limited field of view make it impractical to use, for what we are doing.

What are we doing? We are going to try to locate each of the varieties of white blood cells in the slides. The white blood cell you will first see will be either a lymphocyte or a neutrophil. Which of these will you be most likely to see? ____________________. Let's zero in on a neutrophil. Look around for a cell with an obvious multilobed nucleus. Each nuclear segment is joined by a narrow strip of nuclear material. There may be 3 to 5 such lobes or segments. The cytoplasm of the cell will appear abundant, relatively free of granules and stained a pale lilac shade, normally. Can you find one? Incidently, neutrophils are the most frequently occuring cell and you therefore probably first saw this leucocyte. If you are lost, ask your instructor to help you.

The next most abundant leucocyte is the lymphocyte. These cells exhibit a great deal of variability in size. They all have a dense spherical (circular-appearing) nucleus which generally is dark blue (purple?) in color. some larger

Practice Exercise #9

(Input: Continued)

lymphocytes look like monocytes and may be in transition to this cell. The typical small lymphocyte however is about the size of an erythrocyte or just barely larger. The nucleus is surrounded by a narrow strip of cytoplasm colored "robin's egg blue". Larger lymphocytes have paler-staining nuclei which may show a slight indentation. Look for this cell now.

The most spectacular leucocyte is the eosinophil and these may most easily be identified at intermediate power. Look, at intermediate (10x) power for a cell which appears bright red. Center this cell in the field and switch to high power. You should be able to see an eosinophil. It has bright red granules which obscure a purplish, usually bilobed nucleus. This cell in properly stained preparations is unmistakable. If your red cells appear blue or purplish, your stain is not good and you may find it difficult to identify an eosinophil because the purple dye was not adequately washed out of the cytoplasm of all the cells, including the eosinophils. If such is the case, use someone else's slide. Can you find an eosinophil?

Though monocytes are relatively rare, once seen they are not forgotten. They are BIG. The cytoplasm appears pale and free of granules and the nucleus is pale blue with a dented, indented cleft or C-shaped nucleus of pale blue color. There is much more cytoplasm around the nucleus of this cell than around the lymphocyte which it may resemble. Find a monocyte, now.

Lastly and most uncommonly is the basophil. This small cell may appear to look like a lymphocyte, because the nucleoplasm of the lymphocyte may take a variable stain giving it a mottle appearance. Thus one might construe the mottling as blue granules. However, once you see a basophil, you will not forget it. It looks a bit like a neutrophil, that is the cytoplasm is a pale lilac. The nucleus is typically bilobed as in the eosinophil. But the cytoplasm is

Practice Exercise #9

(Input: Continued)

full of blue-staining granules. Many of these lie along the periphery of the cell, as if they were attached to the cell membrane, But while the cell is "full" of granules, there is a good deal of area free of granules. I never counted granules but I would assume something like 20-30 granules in each cell. Each of these is of reasonable small size also: "dotty" looking. The only way to find a basophil is to do a thorough and systematic search of your slide. Start at the upper left corner and sweep from one side of the cover slip to the other; move down one field of view and return to the left side. Move down one more field and sweep right. Go back and forth in this way until you find one. You can try at intermediate power, but you are more likely to miss a basophil this way. As soon as you find one, let the rest of your fellow students know so that they will be able to see it also. But, it might be a good idea to check with your instructor for confirmation first.

Next look for those blue-staining clusters of cells, the platelets. You should have no trouble finding them. Remember, they look like cellular debris on the slide -- that's almost what you might call them.

There are other cells which you may see which do not fit any category described. Their identification, merit, function, etc. are unknown to the author and perhaps, at least at this time, be ignored. I hate to quell that exploratory urge, but we have to be practical.

Practice Examination #9

Let's have a little test over this material. Actually your best test is your own ability to find the cells in question.

1. How would you identify a neutrophil? That is, which of these descriptions suits the neutrophil best?
   a. A bilobed nucleus partially obscured by bright red dots
   b. A small cell with a dark blue-purple nucleus
   c. A giant among the circulating leucocytes with a pale blue indented nucleus and robin's egg blue cytoplasm
   d. A multilobed nucleus with pale lilac cytoplasm
   e. A bilobed nucleus with blue granules in the cytoplasm
2. The most abundant cell in the slide is the ...
   a. erythrocyte
   b. neutrophil
   c. basophil
   d. monocyte
   e. eosinophil

Practice Exercise #9

Feedback #9

1. Neutrophils are called polymorphonuclear leucocytes because of the complexly lobed nuclear form. So the answer, as you said, was (d) "a multilobed nucleus with pale lilac cytoplasm".
2. The most abundant cell (not leucocyte) on the blood smear slide is obviously the red blood cell or erythrocyte (a). You might with to quibble with me about calling erythrocytes cells, but they are called "red blood cells", and the term erythrocyte refers to "red cells". Though they do not have a nucleus, they still are cytoplasmic entities of a very specialized nature.

POST - TEST

1. List five basic items conveyed by the blood.
2. Name three granular leucocytes
3. Name two agranular leucocytes.
4. Match the correct description from the column at right to each leucocyte listed in the left column.

______ neutrophil	a. Large cells, relatively rare, with much cytoplasm around the indented nucleus
______ monocyte	b. Appears bright red in stained slide
______ lymphocyte	c. Most frequently appearing white cell, with abundant cytoplasm and obvious multilobed nucleus
______ eosinophil	d. Variable size, abundant, with dense spherical nucleus
______ basophil	e. Small cell characterized by cytoplasm full of blue-staining granules, many of which lie along the periphery of the cell

5. Phagocytosis, or cellular eating, is one of the principal activities of the white cells. (Circle correct answer)

   True False

6. Name the two leucocytes specifically involved in phagocytosis
7. Name the leucocyte that may act like gamma globulin
8. Which leucocyte can secrete the anticoagulant heparin?
9. Briefly describe platelets, their function, and site of production
10. List four leucocytes formed in the bone marrow
11. Name the leucocyte generally considered to be produced in the lymph nodes.

POST-TEST ANSWER KEY

1. Heat, hormones, respiratory gases, nutrients, waste products
2. Neutrophils, eosinophils, basophils
3. Lymphocytes, monocytes
4. c. neutrophil
   a. monocyte
   d. lymphocyte
   b. eosinophil
   e. basophil
5. True
6. neutrophils and monocytes
7. lymphocyte
8. basophil
9. Small clustered fragments without nuclei, resembling debris, their function is to store thromboplastin. Platelets are formed in the bone marrow.
10. Neutrophils, eosinophils, basophils, monocytes
11. Lymphocyte

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A PROJECT OF THE LEAGUE FOR INNOVATION IN THE COMMUNITY COLLEGE

NATURE OF A NERVE IMPULSE

by

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INTRODUCTION

One of the more difficult subjects to teach in human physiology is the nature of a nerve impulse.

The idea that all impulses seem to be the same whether for sight or sound or taste or smell is difficult to grasp. It is suggested that a similar wave of depolarization or negativity sweeps along the nerve fiber for all kinds of stimuli and that the only difference is in the part of the brain or spinal cord stimulated and the way it interprets the stimulus.

This will be part 1. of a two part unit. The second part will deal with the manner in which the impulse is relayed from the axon of one neuron to the dendrite of another through a chemically modified area known as a synapse.

A student working carefully through this lesson should in about forty-five minutes have some understanding of the nature of a nerve impulse.

OBJECTIVES OF UNIT

Overall Objective

The student will be able to describe the nature of a nerve impulse.

Sub-Objectives

1. The student will be able to label the parts of a neuron.
2. The student can name the three kinds of neurons from a functional standpoint.
3. The student can name the three kinds and list the three structural kinds of neurons.
4. The student can explain positive and negative ions and electrolytic charges.
5. The student can list the ions specifically involved in the depolarization of a neuron.
6. The student can state the factor most directly involved in the speed of a nerve impulse.
7. The student can list the different kinds of nerve stimuli.
8. The student can explain the difference between a nerve stimulus and a nerve impulse.

PRACTICE EXERCISE #1

Input: A neuron is a nerve cell.

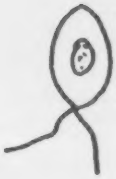
It is the structural and functional unit of the entire nervous system.

The brain is composed of more than twenty billion neurons. The spinal cord has many more billions.

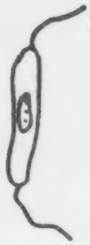
The neuron can be classified into kinds on the basis of both structure and function.

Structural Classification:

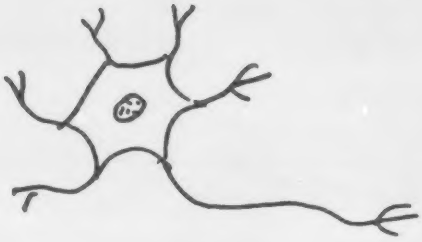
1. Unipolar
2. Bipolar
3. Multipolar



Unipolar



Bipolar



Multipolar

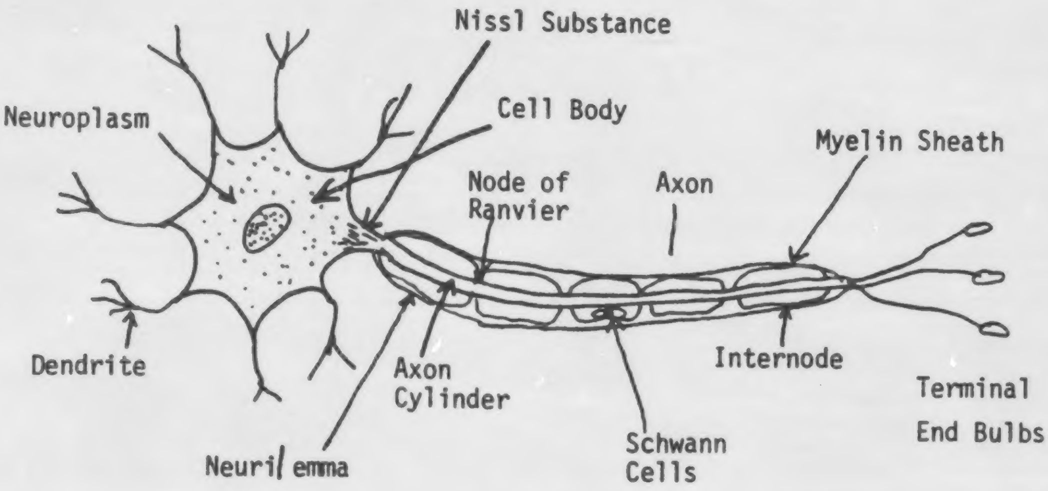
Most neurons in the human nervous system are multipolar.

Functional Classification:

1. Afferent - Sensory (picks up stimuli)
2. Efferent - Motor (produces action or response)
3. Associative - Connective (connects above two)

Afferent, efferent and associative neurons have essentially the same structure but not the same function. A sensory neuron is only sensory and a motor neuron is only motor. Each is unidirectional. Associative neurons are found between afferent and efferent neurons.

Structure of Neuron:


Nissl Substance
Neuroplasm
Cell Body
Myelin Sheath
Node of Ranvier
Axon
Dendrite
Axon Cylinder
Internode
Terminal End Bulbs
Schwann Cells
Neuri/emma

PRACTICE QUESTION #1

1. What is the structural and functional unit of the entire nervous system?

2. Name the three kinds of neurons from the functional standpoint.

   ____

   ____

   ____

3. What is the most common neuron in the nervous system from the structional standpoint?

4. What is an afferent neuron?

5. What is an efferent neuron?

6. Can the sensory neuron also function as a motor neuron?

You are off to a good start! Check your answers on the next page.

Feedback: Practice Questions #2

1. The unit of structure and function is the _neuron_.

2. Three functional kinds of neurons are:

   Afferent - sensory

   Efferent - motor

   Associative - connective

3. Most human neurons are _multipolar_.

4. An afferent neuron is _sensory_ - receives stimuli.

5. An efferent neuron is _motor_ - produces action or response.

6. All neurons are _unidirectional_ - _one cannot_ be substituted for the other.

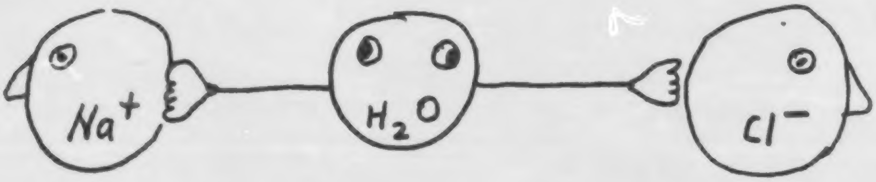
Did you get them all right?

You are now ready for practice Exercise 2.

Be sure you can identify the parts of a neuron. You may have to do it later.

PRACTICE EXERCISE #2

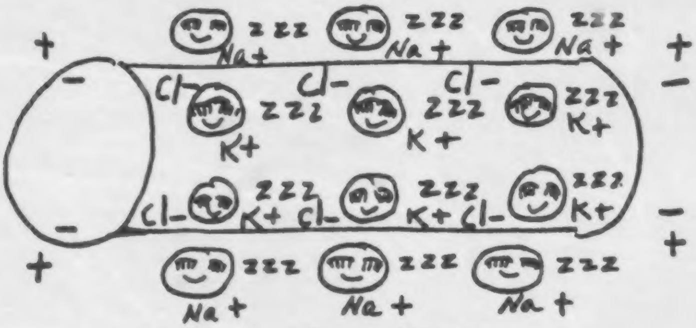
Input: Certain compounds when put in water dissociate. They break down into positive and negative particles called ions. Such a compound is called an electrolyte. The water molecules keep the ions apart. (Salt NaCl) for example, breaks down in water into positive sodium Na^+ ions and negative Cl^- chlorine ions with water molecules separating the two.



Ions, formed in this manner are very important in all body functions including the transmission of a nerve impulse.

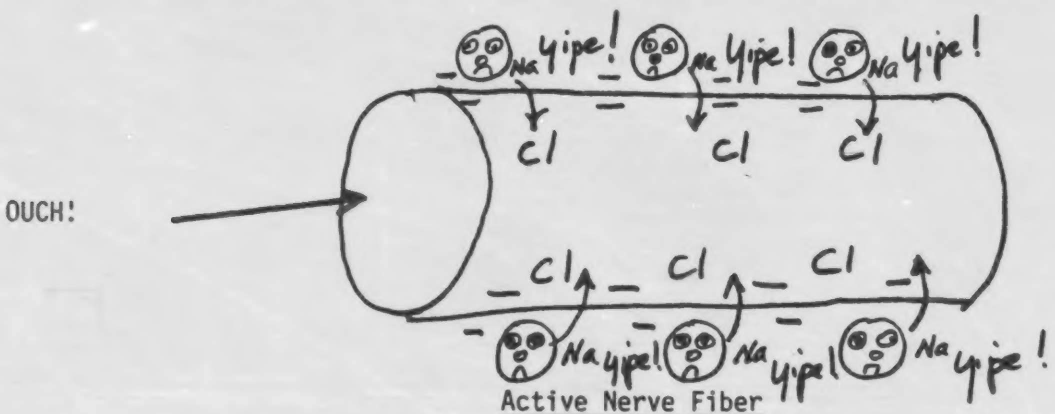
A nerve impulse is a wave of negative ions that sweeps along a nerve fiber. (A "Self-propogating wave of negativity.")

When a neuron is at rest, the cell membrane is impermeable to the sodium and potassium ions arranged along the cell membrane with Sodium (Na^+) on the outside and potassium (K^+) on the inside. An excess of negative chlorine ions on the inside, however, produces an overall negative charge on the inside of the membrane and hence a polarized membrane.



Resting Nerve Fiber

When a neuron is stimulated with a threshold or adequate stimulus, the nerve cell membrane becomes permeable to the sodium and the potassium. The sodium diffuses to the inside and that part of the neuron temporarily becomes negative.



Active Nerve Fiber

The neuron that was polarized

Suddenly becomes depolarized

This wave of depolarization sweeps along the neuron and constitutes the nerve impulse.

It is known as an "action potential". This action potential is the nerve impulse.

The depolarization of a given point on the nerve membrane lasts just a thousandth of a second because positive K^+ ions on the inside of the cell membrane move rapidly to the outside and the resting potential (repolarization) is restored.

A pumping action must now occur in the resting neuron to pump the sodium ions back to the outside and return the potassium ions to the inside so that the neuron is ready to be stimulated again. This is know as the sodium "pump".

PRACTICE QUESTION #2

1. What is an electrolyte:
2. What is an ion?
3. What is meant by dissociate?
4. What ion is located along the outside of a resting neuron?
5. What ions are located on the inside of the neuron?
6. What kind of stimulus is required to activate a neuron?
7. What is meant by polarization?
8. What is meant by depolarization?
9. Describe a nerve impulse based upon polarization
10. What is the difference between a nerve stimulus and a nerve impulse?

You're well on the way! See if you answered all of the above correctly.

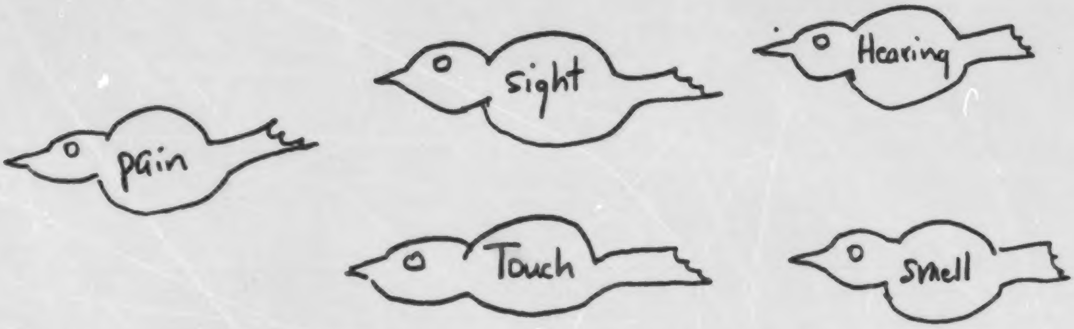
Answers on next page.

Feedback: Practice Questions #2

1. Compounds that dissociate in solution are called electrolytes.
2. Ions are the dissociated particles from an electrolyte. They may be positive or negative.
3. Dissociate means to break down a compound, which is an electrolyte, into its component ions.
4. Sodium (Na^+) is concentrated on the outside of a resting neuron.
5. Potassium (K^+) is concentrated inside the cell membrane along with chlorine ions (Cl^-).
6. A stimulus is any change in the environment.
7. A threshold or adequate stimulus is required to activate a neuron. This is a stimulus strong enough to affect the permeability of the nerve cell membrane to sodium ions. A subthreshold stimulus is not strong enough to do this.
8. When positive and negative ions are aligned on opposite sides of the cell membrane of the neuron, it is polarized.
9. When sodium diffuses through the cell membrane to the inside and both sides become momentarily negative, the neuron is depolarized.
10. A nerve impulse is a wave of depolarization (negativity) that sweeps along a neuron.

PRACTICE EXERCISE #3

Input: A difficult concept to grasp is that all stimuli seem to be the same.



The stimulus for pain, sight, smell, taste, hearing, touch as well as for worry and learning and thinking and all other stiumuli seems to be that same old wave of negativity (depolarization) that sweeps along the neuron.

As long as the light, sound, touch, smell, taste, etc., are strong enough (threshold stimulus) to change the nerve cell permeability, so that sodium and potassium can diffuse through and depolarize the cell membrane, there follows a nerve impulse.

The difference in response seems to be due to the region of the brain stimulated (or spinal cord for certain reflexes) and how it is interpreted, not the nature of the stimulus.

PRACTICE QUESTION #3

1. What is the difference between the stimulus for hearing and sight?
2. What is the difference between the stimulus for smell and taste?
3. What is the difference between the stimulus for touch and pain?
4. What is a threshold stimulus?
5. Are all stimuli the same?
6. Where are stimili interpreted?

Don't give up! You have only one more section. Be sure and check your answers on the next page.

Feedback: Questions #3

1. There is no difference between stimuli for hearing and sight.

2. There is no difference between stimuli for smell and taste.

3. There is no difference between stimuli for touch and pain.

4. A threshold stimulus is one strong enough to cause a response. If the stimulus is strong enough to knock down the first domino, the entire row will fall down: Self-propogating.

5. All stimuli are the same.

6. Stimuli are interpreted as smell, taste, sound, pain, touch, etc., in specific areas of the brain.

PRACTICE EXERCISE #4

Input: The speed with which a stimulus travels over a neuron seems to depend largely on the size of the neuron and the distance between the Nodes of Ranvier.

Nerve fibers are divided into three classes based on the size of the fiber:

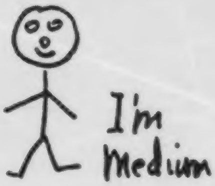
Class A fibers - stimuli - 100 meters per second

Class B fibers - stimuli - 30-50 meters per second

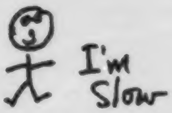
Class C fibers - stimuli - 1/2 meter per second

I'm Fast

I'm Medium



I'm Slow



Intensity of stimulus has nothing to do with speed. It is just like a gun. The speed of the bullet has nothing to do with how hard you pull the trigger.

Touch may travel very fast (Class A fiber). Heat and cold more slowly (Class B); while it may take some time after an injury to feel pain (Class C).

PRACTICE QUESTIONS #4

1. Which nerve fiber carries impulses the fastest?
2. Give an example of a stimulus carried over a Class A fiber.
3. What stimulus might travel over a Class B fiber.
4. Give an example of a Class C stimulus.
5. True or False. The stronger the stimulus, the faster it travels.

Whew! You're almost finished. If you can handle these questions and the Post Test, you've got it made.

Feedback: QUESTIONS #4

1. Class A fibers carry stimuli the fastest, up to 100 meters per second.

2. Touch is felt very quickly.

3. It may take more time to feel and tell the difference between heat and cold.

4. Have you ever noticed how you can cut or injure yourself and not feel pain for quite awhile?

5. False! If a stimulus is of threshold intensity (enough to start the reaction), "It's all or nothing". If you once get a fuse lighted, it doesn't make any difference whether you lighted it with a match or a blowtorch. The explosion will be the same.

POST TEST

1. Sketch a neuron and label the cell body, dendrites, axon, neuroplasm, Nissl substance, axon cylinder, neurilemma, nodes of Ranvier, internodes, myelin sheath, Schwann cells, and terminal end bulbs.

2. a. What is an electrolyte?
   b. What is a non-electrolyte?
   c. What is an ion?

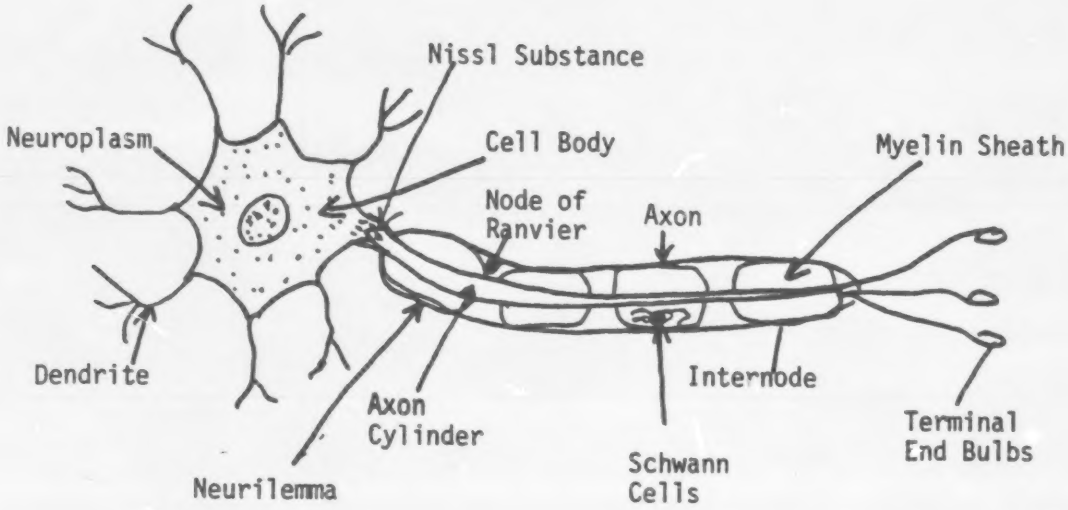
3. a. Which element predominates outside the nerve cell membrane?
   b. Which elements are specifically associated with the inside of the cell membrane?
   c. What is polarization?
   d. What is depolarization?
   e. What is the relation of depolarization to a nerve stimulus?

4. a. What is a Class A nerve fiber?
   b. What is a Class B nerve fiber?
   c. What is a Class C nerve fiber?
   d. Which fiber transmits stimuli the fastest?
   e. What determines the speed of a nerve stimulus?

5. a. Is the nerve stimulus for sight different from the one for hearing?
   b. Is the nerve stimulus for smell different from the stimulus for taste?
   c. Is the nerve stimulus for touch different from the stimulus for pain?
   d. Is the nerve stimulus for worry different from the stimulus for learning?
   e. What is a nerve stimulus?

ANSWERS TO POST TEST

1.


Nissl Substance
Neuroplasm
Cell Body
Myelin Sheath
Node of Ranvier
Axon
Dendrite
Internode
Axon Cylinder
Terminal End Bulbs
Schwann Cells
Neurilemma

2. a. An electrolyte is a molecule that dissociates or breaks down into positive and negative ions when dissolved in water. (i.e., salt)

   b. A non-electrolyte does not break down into ions when dissolved in water. (i.e., sugar)

   c. An ion is the positive or negative particle produced when an electrolyte dissociates in water. (i.e., NaCl Na^{+} Cl)

3. a. The dominant element on the outside of a polarized neuron is sodium (Na^+).

   b. The major element inside the neuron cell membrane is potassium (K^+) and chlorine Cl^-.

   c. A neuron is polarized when the electrical charge is positive on the outside of the neuron and negative on the inside.

   d. A neuron is depolarized when the positive and negative ions are redistributed so that that portion of the neuron is negative.

   e. A nerve impulse is a wave of depolarization (negativity) that sweeps along a neuron.

4. a. A Class A fiber is the largest nerve fiber.

   b. A Class B fiber is the medium sized fiber.

   c. A Class C fiber is the smallest nerve fiber.

   d. Class A fibers transmit stimuli the fastest, i.e., 100 meters per second. Class B fibers transmit stimuli at a more moderate speed, i.e., 30-40 meters per second. Class C fibers transmit stimuli very slowly, i.e., 1/2 meter per second.

   e. The speed of a nerve stimulus therefore seems to depend largely on the size of the nerve fiber and indirectly the distance between its Nodes of Ranvier.

5. a. No.

   b. No.

   c. No.

   d. No.

   e. All nerve stimuli appear to be the same... Each is a self-propogating wave of negativity.

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A PROJECT OF THE LEAGUE FOR INNOVATION IN THE COMMUNITY COLLEGE

THE FUNCTIONS OF THE ORGANS ALONG THE DIGESTIVE TRACT

By

Leland Van Fossen

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TITLE OF PACKAGE: The Functions of the Organs Along the Digestive Tract

AUTHOR: Leland Van Fossen

INSTITUTION: De Anza College,
Cupertino, California

INTENDED STUDENTS: Introductory College Biology

ESTIMATED WORKING TIME: 30-45 Minutes

MATERIALS NEEDED: Human Torso Model (Turtox Supply)

PREREQUISITES: Some basic cell structure and basic chemistry is assumed

REVISED: November 15, 1977

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INTRODUCTION

You are about to embark on a voyage down the human digestive tract. As you move along the tract you should ask yourself how food is made small enough to be useful to the rest of the body - especially in your cells. It is important for you to remember that for you to take full advantage of the material you eat, digestion must start by chewing the food well as it enters the digestive tract. This punctures cells that comprise potatoes, fruit, meats, and grains and releases large molecules on which digestive enzymes may function.

This package is designed to help you understand not only the structure of the digestive tract, but the functions of these structures. Structure and function are complimentary and are found from the atomic level up to the organismic level.

You will be expected to know several terms and ideas as they relate to digestion. To aid you in this regard, I have listed the terms in the "Glossary" at the end of this learning package.

The specific objectives of this learning package will be found if you decide to continue. Upon completion of this package a "Post-Test" will allow you to determine how well you have learned these sub-objectives. If you know the sub-objectives you may wish to take the "Post-Test" now.

In addition, it is also hoped you will anonymously report on the value of this package to you.

THE FUNCTIONS OF THE ORGANS ALONG THE DIGESTIVE TRACT

Overall Objective

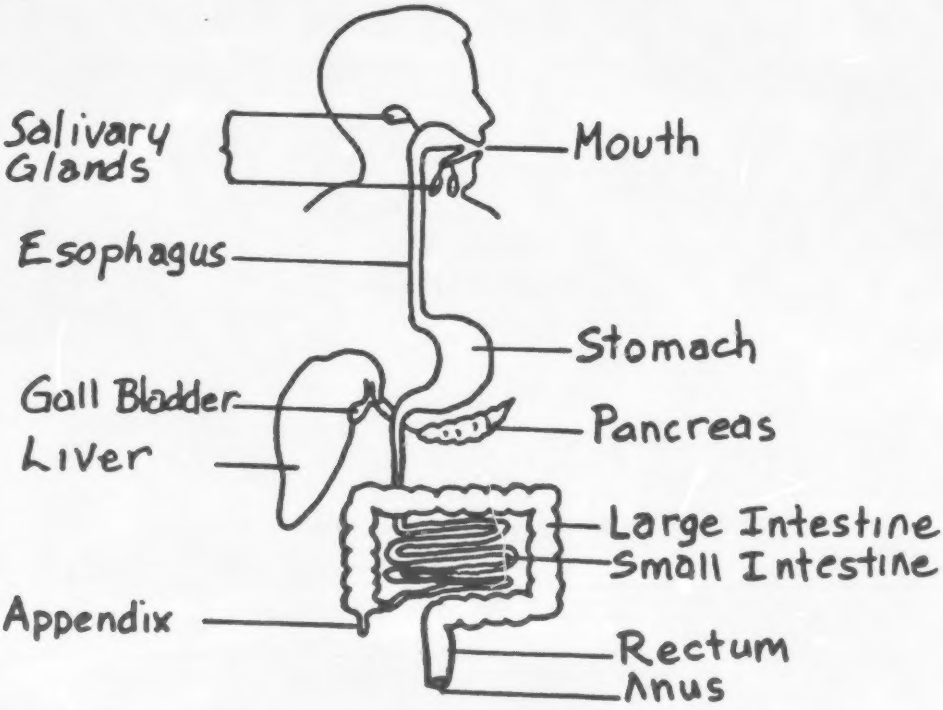
When you finish this package you should be able to describe some of the physical and physiological activities of your digestive tract.

Sub-Objectives

1. List the major roles of: mouth, esophagus, stomach, small intestine, and large intestine.
2. Sketch the digestive system and give the approximate length of each section.
3. Describe the function of these enzymes: amylase, lipase, pepsinogen, and dipeptidase.
4. Explain how the shift of pH in different regions effects digestion.
5. Compare the functions of the large and small intestines as they relate in length.
6. Describe two causes of ulcers.
7. Demonstrate to yourself that organ structure is related to function.

EXERCISE #1

To aid you in understanding the whole digestive system, let's use the human torso and Figure 1 to identify the components of the digestive tract. Although it is specialized along its length and takes various shapes, the digestive tract can be considered as a tube within a tube. The entrance to this tube, of course, is the mouth. So why don't you take a pencil and trace the pathway of food from the mouth to the anus, on Figure 1.


Salivary Glands
Mouth
Esophagus
Stomach
Gall Bladder
Pancreas
Liver
Large Intestine
Small Intestine
Appendix
Rectum
Anus

I'm sure your line followed this course through the five major regions: mouth, esophagus, stomach, small intestine, and then to the large intestine. Note that it did not go directly through the associated and essential glands, the pancreas and liver.

1a. List, in order, the five major regions of the digestive tract.

1b. List the two major glands associated with that tract.

Answers

1a. Mouth, esophagus, stomach, small intestine, large intestine

1b. Pancreas and liver

If your answers are the same as mine proceed to the next exercise. If not, review the first exercise and try again! You now have an overview of the whole system; next, let's look at the individual organs. Proceed to Exercise #2.

EXERCISE #2

What are the functions of the oral cavity? Look at Figure 2 (tongue). The tongue has a rough surface composed of over 3000 sensitive papillae, such as the three labeled on the right side of Figure 2. The role of taste is in selecting foods to be ingested; for example, would you eat a tuna sandwich that had been sitting in the sun for two days?

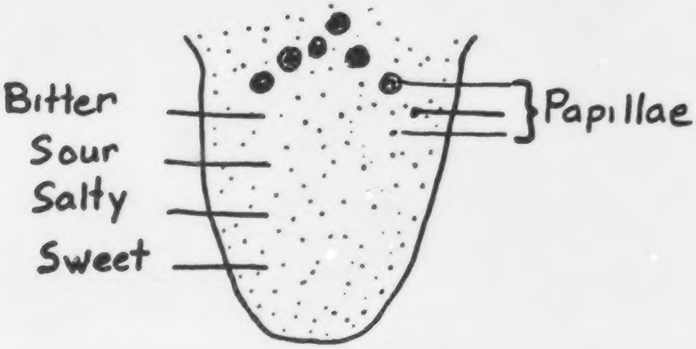


Figure 2: A top view of the tongue showing the location of the taste regions.

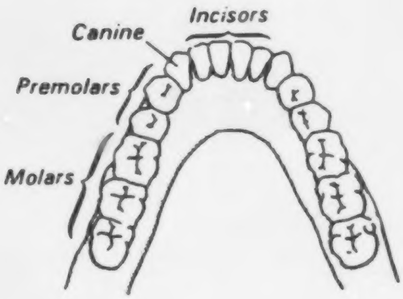


Figure 3: Lower jaw of an adult human, showing different types of teeth identified.

A second function of the oral cavity is the beginning of mechanical digestion. Look at Figure 3 showing the lower jaw of a human being. There is a relationship between the structure and function of teeth. Incisors are sharp and thin for biting, the pointed canines are adapted for tearing, and the broad, flat premolars and molars provide a wide surface for grinding food.

Look at Figure 4 and you will see we have three pairs of salivary glands and each produces salivary amylase. These glands secrete over two pints a day or enough to fill two large swimming pools in a lifetime. Salivary amylase (enzyme) converts starch (substrate) from bread and potatoes into simple sugars (products) in the presence of a slightly acid medium (pH 6). Saliva is also a viscous material that contains mucus and aids the food in moving through the esophagus (about 10 cm long) by involuntary muscular contractions called peristalsis (see Figure 5). It is the alternate contraction of the longitudinal and circular muscle layers in the esophagus (and the rest of the intestine) that moves the food into the stomach.

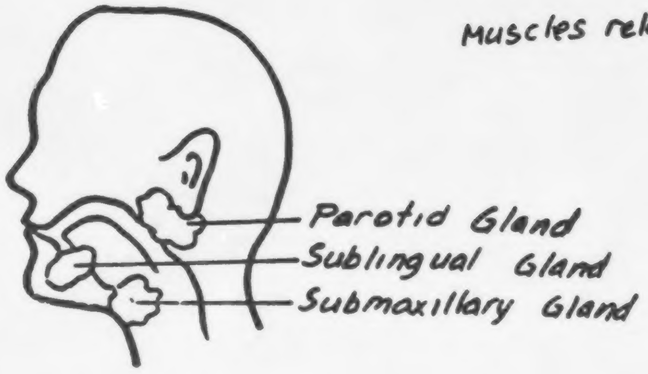


Figure 4: The salivary glands

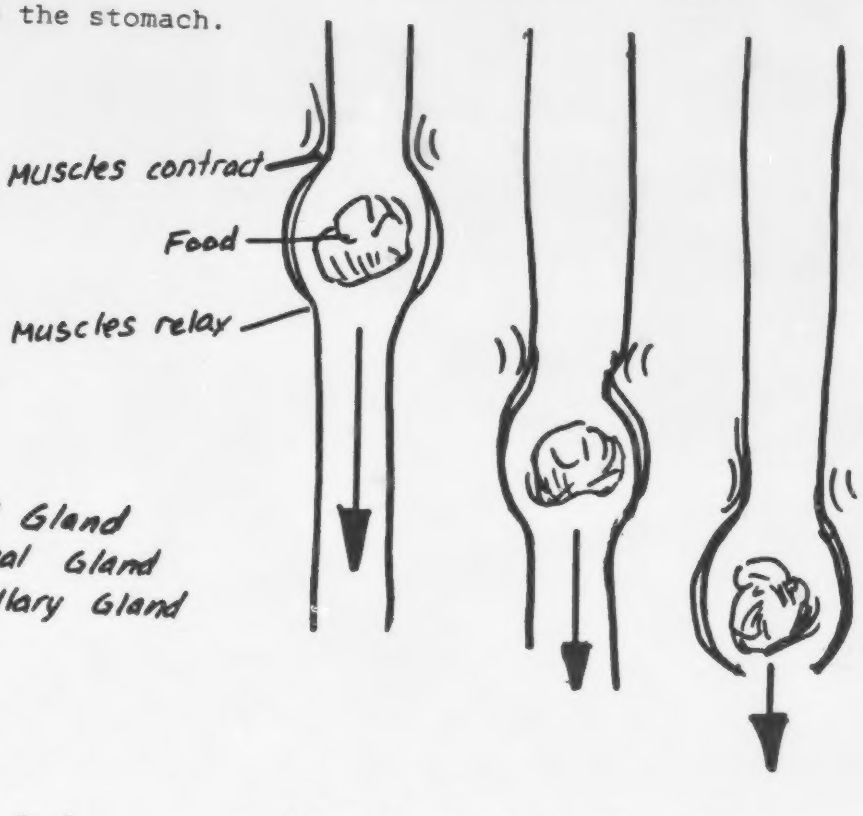


Figure 5: Peristalsis is a wave of muscular contractions that push food ahead.

2a. Describe the location of four taste buds on the tongue.

2b. What is the role of taste to ingestion?

2c. List the four types of teeth and describe the function of teeth.

2d. How is food moved along the esophagus?

2e. How long is the esophagus?

2f. What is the ideal pH of the salivary enzyme?

2g. What does amylase do? (Name the enzyme, substrate and product).

Answers

2a. From front to back we taste sweet, salty, sour, bitter

2b. We have learned to associate taste with good and bad substances which we then ingest or reject.

2c. Incisors-cut, canines-tear, premolars-grind, molars-grind

2d. By involuntary contractions called peristalsis

2e. About 10 cm.

2f. pH 6

2g. Amylase converts large starch molecules into simple molecules of sugar; enzyme=amylase, substrate=starch, product=sugar

EXERCISE #3

Let's consider the role the stomach plays in the digestion process. Figure 6 shows the major regions of the stomach. Food enters through the cardiac sphincter (a muscular ring), stays 2 to 6 hours as it is mixed with gastric fluids and becomes a mushy liquid called chyme. Chyme leaves via the pyloric sphincter. Along with mechanical mixing the stomach secretes pepsinogen (a gastric juice), hydrochloric acid (HCl), mucus and renin. Pepsinogen is secreted and then converted to pepsin in the presence of HCl (pH 1). What causes gastric juices to be secreted? It has been found that certain cells in the stomach lining secrete gastrin, a hormone, in the presence of acid food.

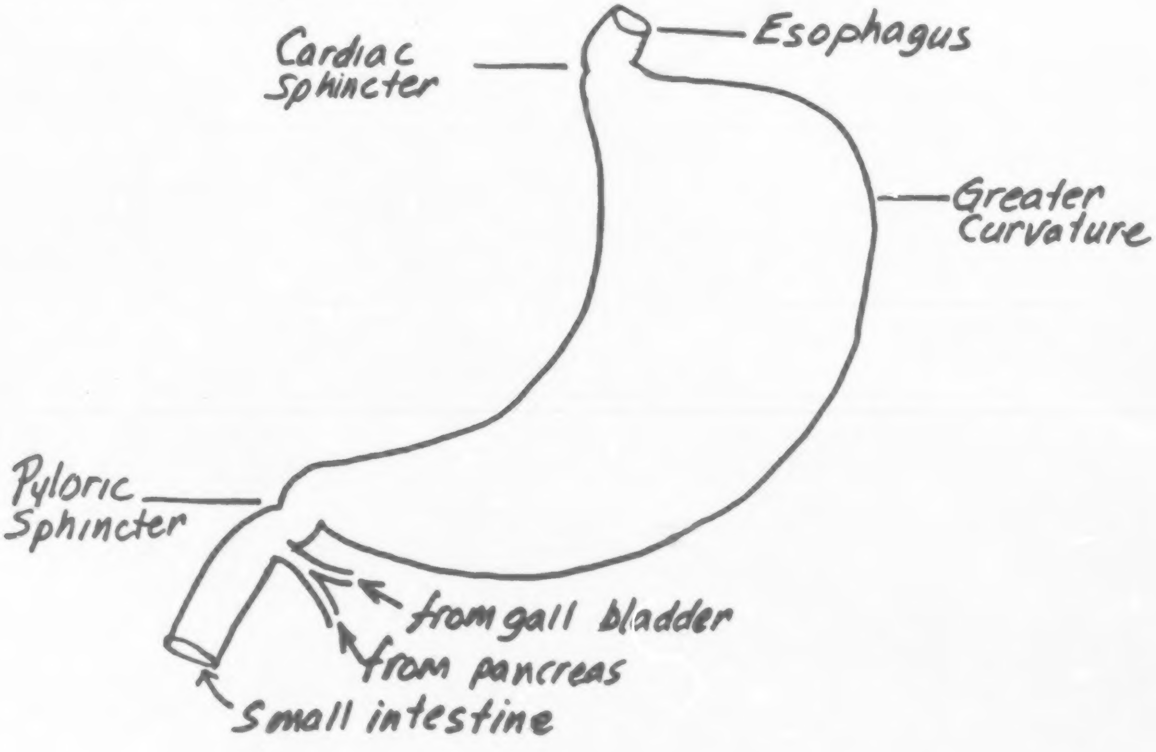

Esophagus
Cardiac Sphincter
Greater Curvature
Pyloric Sphincter
from gall bladder
from pancreas
Small intestine

Figure 6: Regions of the stomach

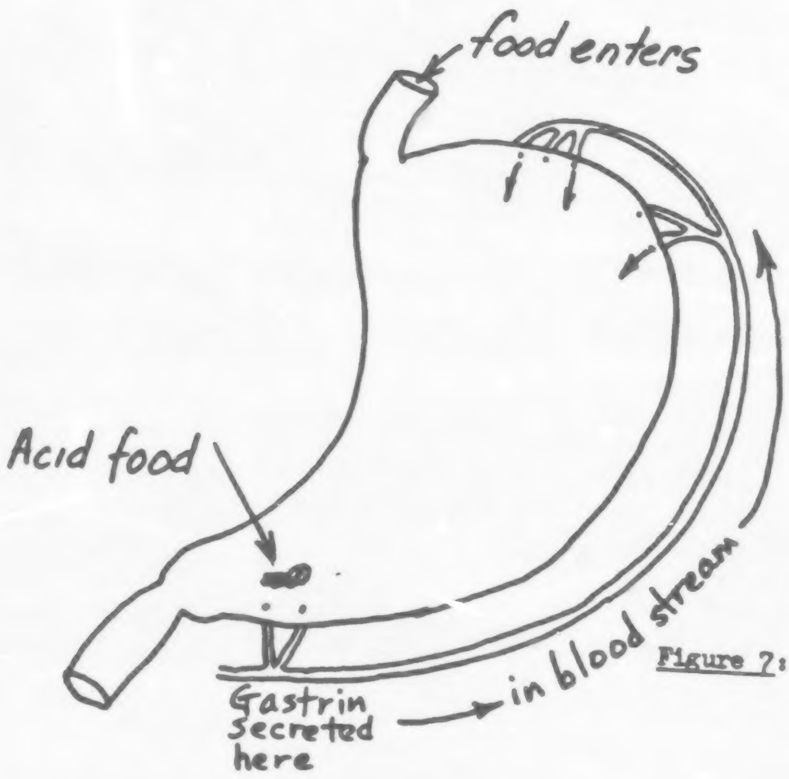


Figure 7: The secretion of gastrin in response to the presence of acid food in the lower part of the stomach.

Look at Figure 7 now. Gastrin travels via the blood to other secreting cells of the stomach and stimulates gastric juice to be produced. Unfortunately, emotional stress can also trigger gastrin to be produced and ulcers can be induced. Mucus helps protect the stomach from being digested by pepsin, a protein digesting enzyme that produces peptide chains. Renin causes milk to form curds, and HCl reacts with minerals (i.e. bone) to form ions as well as destroy bacteria. If too little mucus or too much acid is secreted, the stomach lining may be attacked and digested and an ulcer develops. At present men are four times more likely than women to develop ulcers.

3a. What causes Pepsinogen to be secreted?

3b. How long does food stay in the stomach?

3c. What is the function of mucus in the stomach?

3d. What is the pH of gastric juice and how does this effect salivary amylase?

Answers

3a. Gastrin-a stomach hormone

3b. 2 to 6 hours

3c. Prevents ulcers and lubricates the entire digestive tract

3d. pH 1 (strong acid) - very strong acids destroy most other enzymes, including amylase-starch digestion stops in the stomach.

EXERCISE #4

Mechanical mixing of food and chemical digestion of proteins has started as food leaves the stomach and enters the small intestine. In the duodenal region there are two ducts that enter from the pancreas and liver - gall bladder. What controls the secretory actions of these glands? Figure 8 outlines the series of events that regulate pancreatic secretion. When acid food (pH 1-2) enters the intestine, a hormone called secretin is produced and enters the bloodstream where it finally triggers cells in the pancreas to secrete pancreatic juices. Trypsin and chymotrypsin are listed as protein digesting enzymes and they will only work to break specific bonds between specific amino acids or at specific locations. So, several enzymes are necessary to complete the digestion of protein. Amylase converts polysaccharide to simple sugars, lipase converts fats into fatty acids and glycerol. The pancreatic juice has a pH 8, that is alkaline, which helps neutralize the acid food from the stomach and provide an optimal pH for the digestive enzymes in the intestine. Remember, strong acids (low pH numbers) usually destroy enzymes.

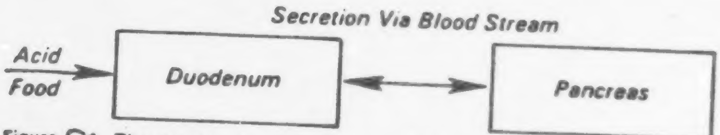


Figure 8: The sequence of events responsible for the release of pancreatic juices into the intestine.

EXERCISE #4

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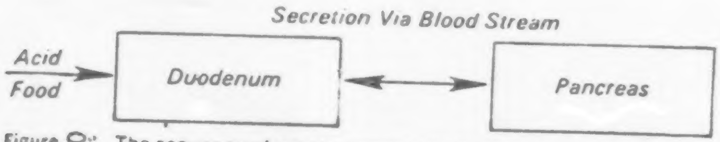


Figure 8: The sequence of events responsible for the release of pancreatic juices into the intestine.

4a. Why is it necessary to have several enzymes to digest protein?

4b. What does a pH shift from acid (low number) to alkaline (high number) have to do with enzymatic activity in the intestine?

Answers

4a. Enzymes have fairly specific targets at which they can cause molecules to degrade to form smaller molecules. Each molecule has one or more enzymes that break it apart.

4b. Most enzymes will not function and will be destroyed in an acid medium.

EXERCISE #5

The Role of the Liver and Gallbladder in Digestion

The liver produces a yellowish fluid called bile which is concentrated and stored in the gallbladder. The bile is concentrated partially as salts by the removal of water. On occasion, cholesterol contained in the bile also crystallizes out to form gallstones. Much of the bile contains the breakdown products of dead red blood cells, and one of these products, called bilirubin, gives feces their brown color. It is the bile salts that are important to digestion. The bile is released from the gallbladder after the acid food has arrived in the intestine. The bile salts act to emulsify the large fat molecules, that is, to break fat into small droplets that provide a much larger surface area of fats on which the enzyme can act to carry out digestion.

Also emptied into the upper intestine are pancreatic juices containing amylase, sucrase, lipase, and dipeptidase. The intestinal wall also secretes many of the enzymes. Remember, these enzymes are making small molecules out of large food molecules. Amylase degrades starch into sucrose, sucrase then degrades sucrose into simple glucose sugars. Lipase degrades fats to fatty acids and glycerol. Dipeptidases convert dipeptides into amino acids.

5a. Of what substances are some gallstones composed?

5b. In your own words, what is the function of the bile?

5c. Name the substrate and products of these enzymes:

1) amylase
2) sucrase
3) lipase
4) dipeptidase

Answers

5a. Cholesterol and other bile salts

5b. Reduces large globs of fat into small droplets of fat

5c. 1) starch(s), sucrose and other double sugars(p)
2) sucrose(s), glucose(p)
3) fat(s), fatty acids and glycerol(p)
4) dipeptide protein(s), amino acid(p)

EXERCISE #6

Digestion is not complete yet, since the digested materials are not useful to the body until they have been absorbed. How is the small intestine structured to promote the bloodstream's absorption of the simple molecules? A cross section of the intestine shows the lining is in folds which increases the total surface area and microscopically there are even more folds known as villi. Small capillaries lie next to the villi and help carry all the following to the body cells: amino acids, simple sugars, and minerals. Fatty acids and glycerol are carried away in a special lymph vessel (lacteal) and carried away by lymph tissue.

After passing through 23 feet of small intestine, any undigested materials, along with wastes such as bilirubin (it causes feces to be brown) and much water, move into the large intestine which is about five feet long. Where the small and large intestines join, there is a "T" called the appendix. There is no known definite function for the appendix, except in causing pain in those people in whom it is infected.

The prime function of the large intestine is reabsorbing much of the water from wastes and secondarily the movement of potassium ions into the blood vessels and an environment for Vitamin K producing bacteria. If too little water is reabsorbed, constipation results; if not enough water is reabsorbed, diarrhea results. Control of bowel movement is by a complex of voluntary muscular contractions, peristalsis, and by control of the sphincter muscles at the anus or terminus of the digestive tract.

6a. What is the role of having numerous villi and micro-villi?

6b. What carries digested glycerol from the intestines to other parts of the body?

6c. What absorbs and transports amino acids and sugars away from the intestine?

6d. How is the length of the small and large intestines related to their functions?

6e. Describe two causes of abnormal bowel movement.

Answers

6a. Villi have much more surface area on which digestion and absorption may occur and this speeds up the digestive process.

6b. Lacteals absorb the fatty acids and glycerol while lymph fluid carry these materials away.

6c. Capillaries

6d. The small intestine is about 23 feet long and it has more surface area for digestion and absorption compared to the five foot long large intestine which mostly absorbs water, vitamins and potassium ions.

6e. Diarrhea and constipation are abnormal functions; the former can be caused by the feces being too wet and the latter can be caused by not enough water in the feces.

POST-TEST

1. Sketch the digestive system as a straight tube and give the approximate length (in feet) for each section.

2. List, in order, the organs of the digestive system and after each list two functions they serve.

3. Describe the function of these enzymes:

    a. amylase

    b. lipase

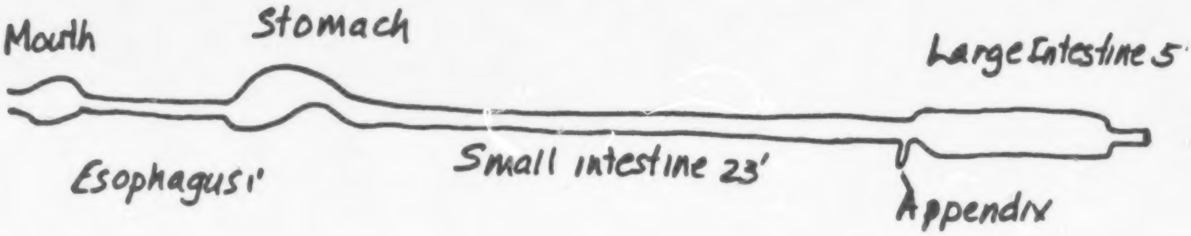
    c. pepsinogen

    d. dipeptidase

4. Two animals are about the same length, but the diameter of the small intestine in one is twice the size of the other animal. How does this difference relate to the absorption rate and probable diet of the two animals?

ANSWERS TO POST-TEST

1.



2.

Organs	Functions
A. Mouth	Mechanical and starch digestion
B. Esophagus	Lubrication and movement of food
C. Stomach	HCl works on minerals and pepsin degrades proteins into dipeptides
D. Small Intestine	Digests dipeptides into amino acids; digests lipids or fats into fatty acids and glycerol; digests double sugars into simple sugars.
E. Large Intestine	Absorbs water and Vitamin K

3. Functions of:

A. Amylase - to break starch into double sugars

B. Lipase - to break fats into fatty acids and glycerol

C. Pepsin - to break proteins into dipeptides

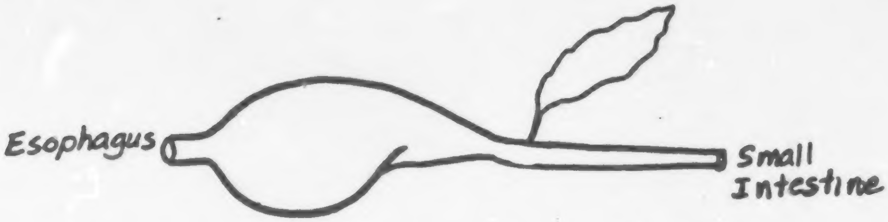
D. Dipeptidase - to break dipeptides into separate amino acids

4. The animal that has the largest diameter has more surface area in its intestine. Animals that have more surface area need more time or surface area to digest difficult foods such as plant tissue. More surface area will also increase the rate of absorption.

POST-TEST (CON'D.)

5. Which of the following most closely resembles peristalsis?
   a. an earthworm moving along
   b. a finger
   c. a glass tube

6. On a diagram of the stomach and small intestine, supply labels(1-4) indicating the sequence of events responsible for the release of gastric juices. Do the same for pancreatic juice by using (A-B-C-D) Also use names for all labels.



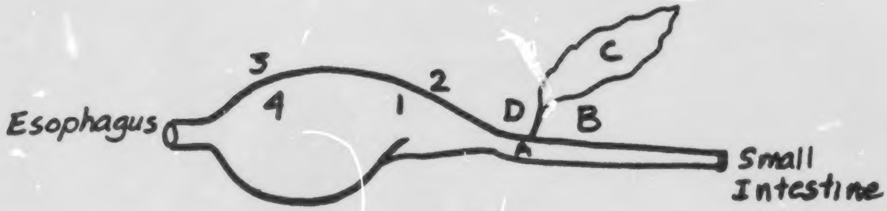
7. Describe the mechanism of peristalsis and state why it is important to digestion.

8. Discuss why the complete digestion of proteins requires the activity of several enzymes as opposed to just one.

9. Please report, on a separate sheet, how you felt about this unit and how important digestion is to you.

5. (a)

6.



Gastric Juices

1. Acid food in stomach
2. Gastrin secreted by stomach
3. Stomach cell secrete gastric juice
4. Gastric juices released to begin digestion

Pancreatic Juices

A. Acid food in duodenum

B Secretion is released from duodenum into bloodstream

C. Pancreas stimulated by secretion to release pancreatic juice

D. Pancreatic juice flows into small intestine.

7. Paristalsis is a muscular wave of contractions and relaxations in one direction. The process pushes food from one end to the other end of the digestive tract.

8. Proteins are composed of thousands of amino acids and digestion occurs in short steps, therefore, many enzymes are necessary to break a protein into small units of amino acids.

9. The author hopes you found the unit useful in emphasizing to you how very important digestion is.

GLOSSARY

AMYLASE: A starch-digesting enzyme.

APPENDIX: A blind pouch at the intersection of the large and small intestine.

CALORIE: A unit of energy equivalent to the amount of heat required to raise the temperature of one gram of water by one degree Celsius.

CARBOHYDRASE: An enzyme that digests carbohydrates.

CARBOHYDRATES: Organic compounds with the general formula $(CH_2O)_n$, including sugars, starches, and cellulose.

CHYME: The semifluid mass of partly digested food expelled by the stomach into the duodenum.

DIGESTION: The process by which large nutrient compounds are chemically broken down by the action of digestive enzymes.

DIPEPTIDASE: An enzyme that converts dipeptides into amino acids.

ENZYMES: Organic molecules that catalyze biochemical reactions. In this minicourse, the enzymes referred to are hydrolytic in nature; i.e., they break down large molecules into their smaller components, while adding the elements of water.

GALL BLADDER: Stores bile and secretes it into the small intestine.

INGESTION: Eating or taking in food materials prior to digestion.

LIPASE: An enzyme that digests fats, or lipids, into fatty acids and glycerol.

LIPIDS: Fats and related food compounds that are soluble in nonpolar solvents. Of the three basic types of food materials, lipids contain the most energy per unit mass, and they are also important structural units in cell membranes.

PERISTALSIS: The alternating constriction and relaxation of the digestive tract, which accounts for food movement through the tract.

PHARYNX: The part of the digestive tract between mouth and esophagus.

PEPSINOGEN: An enzyme that initiates protein digestion.

PROTEINS: A class of nutrient compounds whose primary structure consists of long chains of amino acids. These compounds are important to the body both as structural elements and as enzymes.

SUBSTRATE: Chemical that is degraded by enzymes into smaller molecules or products.

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A PROJECT OF THE LEAGUE FOR INNOVATION IN THE COMMUNITY COLLEGE

INTRODUCTION TO THE EPIDEMIOLOGY OF INFECTION

An overview of the infectious process

By

Reba Douglass Grubb

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TITLE OF PACKAGE:	INTRODUCTION to the Epidemiology of Infection: An Overview of the Infectious Process
AUTHOR:	Reba Douglass Grubb, B.S.
INSTITUTION:	Tucson Medical Center
INTENDED STUDENTS:	Hospital employees; Community health
ESTIMATED WORKING TIME:	45 minutes
MATERIALS NEEDED:	(Optional) Text Book-"Infection, Prevention and Control", Chapt. 1, E. Dubey and R. Grubb, C. V. Mosby Co.

FIELD TEST COPY

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OBJECTIVES OF UNIT

Overall Objective

To help the learner apply knowledge of the factors involved in the infectious process toward the possibility of preventing or controlling a particular infection.

Sub-Objectives - The learner will be able to:

1. Define the terms EPIDEMIOLOGY
   EPIDEMIC
   PANDEMIC
   ENDEMIC
2. State the 6 factors involved in the infectious process, in sequence of involvement.
3. Describe microbial or infectious agent factors that live and multiply. Give 2 examples of agents capable of producing disease.
4. Describe the source or reservoir factor in which the agent develops. Give examples of inanimate sources.
5. Describe the modes of transmission.
   Give examples of direct and indirect modes.
   Give examples of intermediaries of transmission
6. Give examples of portal of exit and portal of entry factors.
7. Describe the factors in the agent's maturation and multiplication in the new source (a susceptible host).
8. List factors that contribute to the lowering of the body's resistance to infection.

INTRODUCTION

PURPOSE: To provide an instructional packet for use in the hospital, school, or community to help the learner become familiar with the epidemiology of infection; to use this knowledge to recognize factors involved in the infectious process of a disease or condition, that steps may be taken to either prevent or control an infection.

OVERVIEW: The development of an infectious disease is dependent on a sequence of factors, often referred to as a cycle. If these factors are known, the knowledge may be applied to known or suspected infectious diseases or conditions and the cycle broken to prevent or control an infection. Prevention relates to eliminating the occurrence of a disease or infection. Control pertains to restricting the spread of existing diseases or infections.

The goal is for the learner to become so familiar with the factors involved in the infectious process that the cycle, or sequence of factors, can be broken and infection prevented or controlled as possible.

CONTENT INCLUDES:

1. Definitions of terms relating to the epidemiology of infection
2. Factors involved in the infectious process
3. Discussion of each factor

Teaching aid

Table: THE INFECTIOUS PROCESS
a sequence of factors
Text: INFECTION, PREVENTION AND CONTROL, Chapter 1
Dubay, E. and Grubb, R., C.V. Mosby Company,
2nd edition, 1978

THE INFECTIOUS PROCESS

Sequence of Factors

Causal agent lives and multiplies in a reservoir or source; escapes through a portal of exit; is transmitted by various modes of transmission; to portal of entry in new host; where it lives and multiplies. Result: new host develops an infectious disease.

Agent	Reservoir	Portal of Exit	Mode of Transmission	Portal of Entry	Result
BY INDIRECT VEHICLE CONTACT					
Shigella dysenteriae Group A →	Man →	Anus by defecation ⤻	Man's hands: (unwashed after defecation) to ↓ raw vegetable salad prepared by infected man →	Mouth: as new host eats infected food →	Dysentery in new host
BY DIRECT CONTACT					
Treponema pallidum →	Man →	Genital area of host →	Sexual intercourse →	Genital area of new host →	Syphilis in new host
BY INDIRECT VECTOR CONTACT					
Plasmodium malariae →	Man and vector female Anopheline mosquito →	Skin of host ⤻	Insect feeds on infected man and becomes infected ↓ bites new host	Skin of new host →	Malaria in new host
BY DIRECT CONTACT - DROPLET					
Myco-bacterium tuberculosis →	Man →	Mouth →	Droplet: Mouth to mouth resusication or coughing →	Nose and mouth of new host →	Tuberculosis or Meningococcal Meningitis in new host

PRACTICE EXERCISE #1

Epidemiology is the study of the occurrence and distribution of disease as it is prevalent in man. It is based on the history of disease as known by experts or experienced by the populace:

1. Frequency and modes of development of disease in its relationship to climatic conditions
2. Habits of the populace and their attitudes toward disease
3. Specific means used for prevention and control.

Epidemic is a term applied to the occurrence of a disease in many people at the same time or in rapid succession:

1. In one or more persons in an area where the disease had not previously been recognized.
2. In one or more persons where the disease, such as smallpox, had not been reported in at least ten years.

Pandemic is when a disease is epidemic at the same time in many different parts of the world.

Endemic is a disease that is generally present in a given locality in a certain number of the population. Most infectious diseases are endemic in some locality and do not usually become epidemic. For example, a number of cases of measles may occur within a school room in those students who have not been immunized.

> An endemic disease may become epidemic if a considerable number of persons lack immunity or if the infectious agent suddenly becomes more virulent than usual.

Practice Question #1

Define the following terms: Epidemiology, Epidemic, Pandemic, Endemic. Explain when an endemic disease may become epidemic.

Feedback

Check the input for this practice exercise. If, in your own words, you have given definitions similar to those on Page 3, you may proceed to exercise 2. You may also have added some examples of familiar diseases that have occurred in your community and listed them according to the terms you defined.

PRACTICE EXERCISE #2

The development of any infectious disease is dependent on a sequence of factors often referred to as a cycle. Breaking this cycle is vital in the prevention and control of infection. The factors involved in this infectious process are as follows, in sequence of involvement:

a. The microbial or infectious agent that lives and multiplies

b. The source or reservoir in which it develops

c. Its escape through the portal of exit

d. Its transmission by various modes

e. Its entry into the new source through the appropriate portal of entry

f. Its maturation and multiplication in the new source (a susceptible host)

The agent must be sufficiently virulent to produce a disease state in man. Either the organism's secretions or excretions or the organism itself must invade the cell. Once this happens, destruction of the cell or multiplication of the organism or both occur.

Some of the organisms capable of producing diseases are bacteria, protozoa, rickettsiae, fungi, viruses, and helminths.

Practice Question #2

A. Study the table on THE INFECTIOUS PROCESS. Read the input above. List the six factors of the infectious process, in sequence of involvement.

B. The infectious agent is the first factor in the infectious process cycle. Explain the primary role of the infectious agent as related to the infectious process. Give two examples of agents capable of producing diseases.

Feedback

A. Check the input section on Page 4. If you have listed the factors from a--f in that order, you have answered the question. Remember that the cycle of infection may be broken by eliminating one of these factors.

B. If you have answered that the agent must be sufficiently virulent and that the organism's secretions or excretions, or the organism itself must invade the cell you have explained the primary role of the infectious agent. If you named two of the following agents you have fulfilled the second part of the question: Bacteria, protozoa, rickettsiae, fungi, viruses, and helminths.

PRACTICE EXERCISE #3

The SOURCE or RESERVOIR is the environment, either human, animal, or inanimate, in which the organism lives and multiplies. The human source in the hospital involves the entire hospital population--patients, personnel, visitors, and others who enter the hospital environment for any reason.
Humans who act as sources for specific disease organisms may either:

1. have a typical case - usually able to show visible symptoms

2. have a mild, atypical, or unrecognized case - symptoms may be so slight that the disease goes unrecognized and unreported.

3. have a latent or dormant case - some infections such as tuberculosis, the organism can remain latent or dormant for years. Although the organism is still present in the body, there are no symptoms until the presence of the organism is manifested later, at a time when the host's body resistance is lowered.

4. be a carrier - a healthy person who harbors disease-producing organisms in the body but has not developed symptoms of the illness at any time. Example, Typhoid Mary.
   Convalescent carriers (such as patients with hepatitis) remain a source of infection long after the major symptoms have disappeared. Some remain carriers the rest of their lives.

Common inanimate sources are soil, air, food, water, milk, feces, and fomites. Fomites are such things as drinking glasses, silverware, toilet articles.

Practice Question #3

Define SOURCE or RESERVOIR as they relate to the infectious process. Give examples of inanimate sources.

Feedback

If you answered that the source or reservoir is the environment, either human, animal or inanimate, in which the organism lives and multiplies, you have defined source or reservoir. If you named two or more of the following sources you have answered the question: soil, air, food, water, milk, feces, fomites.

You may have added some information on humans who act as sources.

PRACTICE EXERCISE #4

PORTAL OF EXIT is a place or opening through which the agent may escape from the source or reservoir. Examples of these are the nose, mouth, eyes, ears, genitals, broken skin, lesions, wounds, urinary or intestinal tracts, or before birth, the placenta.

Practice Question #4

Define PORTAL OF EXIT in relation to the infectious process. Give examples.

Feedback

If you defined the portal of exit as a place or opening through which the agent may escape from the source or reservoir, you have answered part 1 of the question. Two or more of the following may be given to fulfill the second part of the question: nose, mouth, eyes, ears, genitals, broken skin, lesions, wounds, urinary or intestinal tracts, placenta.

PRACTICE EXERCISE #5

MODE OF TRANSMISSION is the transfer of infective organisms from one host, or source, to another. The relative danger of spread depends on the ability of the organism to survive outside the reservoir. Organisms with a low survival rate outside the reservoir are commonly transmitted through personal contact with infected hosts.

Direct transfer may be one of three types:

1. Actual physical contact, as in venereal disease transmission through kissing or sexual intercourse, which permits body contact with secretions that are harboring the infective organisms.
2. Some organisms with a short survival time may be directly transmitted through infectious droplets that are coughed or sneezed within close range of a susceptible host. Meningitis (meningococcal) organisms are protected from the environment by means of a mucous coating, or by their spore form, and can remain viable for long periods of time. M. tuberculosis in sputum will be infectious for several weeks.
3. Contaminated hands are probably the most important medium of transmission, especially the fecal-oral route in the spread of enteric diseases such as salmonellosis and hepatitis. Washing of hands after toileting will prevent this route of spread. Unwashed hands that are put in the mouth or carry raw food to the mouth are a major source of spread.

Indirect transfer involves an intermediary on which the infective organism persists outside the reservoir until it is transferred to another host. Such intermediaries are known as vehicles and vectors.

Vehicle - may be water (typhoid), milk (bacillary dysentery and tuberculosis), air (respiratory infections), or fomites. Fomites are inanimate objects such as drinking glasses, silverware, and toilet articles that have been contaminated by the infected patient or visitor. The organisms may remain alive on these fomites and be transmitted to the mouth or nose by the hands; by eating with the contaminated silverware or by drinking from the contaminated glass.

Vectors - are mainly arthropods (such as insects) that transmit pathogenic organisms by either mechanical or biologic means. The organisms transmitted are usually species specific -- mosquitos carry yellow fever, ticks transmit Rocky Mountain spotted fever, and flies transfer the typhoid bacillus.

In mechanical transmission, the infected organism may adhere to the insect's body and be carried from place to place. For example, flies may carry organisms from excreta to food, causing dysentery, typhoid fever or cholera.

Biologic transmission takes place when the insect (mosquito, louse, tick) acts as an intermediate host by biting an infected host, ingesting the organism, harboring it for a time and then finally transmitting the infective organism through biting another host, or through its feces.

Practice Question #5

This question has several parts, all related: 1)Define MODES OF TRANSMISSION in relation to the infectious process. 2)Give examples of three types of direct transfer. 3)Give examples of indirect transfer. 4)Explain intermediaries as related to involvement of the infectious process. 5)Give examples of vehicles as intermediaries; 6)example of vectors as intermediaries. 7)What is meant by MECHANICAL means? 8)What is meant by BIOLOGIC means?

Feedback

Look back at the input on Page 9. If your answers are comparable to those found on the sheet, you have answered all of the questions.

Modes of transmission are very important in the cycle of infectious process. If these modes can be eliminated, the cycle is broken. For example, if the individual would practice good hygiene, especially handwashing, 95% of enteric diseases could be prevented.

PRACTICE EXERCISE #6

The PORTAL OF ENTRY is the place or opening through which the infective organism enters the new host. This is usually the same as the portal of exit.

Practice Question #6

Go back to Practice Exercise #4 and read the examples of portals of exit. Turn the page and write down as many of these portals as you can remember.

Feedback

Portals of exit from the source or reservoir of the infective host are the same as the portals of entry into the new host (susceptible host). If you named three or more of the following portals of exit you have named the portals of entry: Nose, mouth, eyes, ears, genitals, broken skin, lesions, wounds, urinary or intestinal tracts, placenta.

PRACTICE EXERCISE #7

The new host must be susceptible before the organism is able to cause an infection or disease. The body's resistance may be lowered, making the host susceptible. Hosts that are immune to a particular infection or disease will not be affected. A host may be a human or an animal that harbors or nourishes another organism (parasite).

Practice Question #7

Explain the term HOST in relation to the infectious process.

Feedback

Reread the input. If your answer is comparable, you have fulfilled the practice question.

It is important to remember that the host must be susceptible before the organism is able to cause infection.

PRACTICE EXERCISE #8

The body's resistance may be lowered through several factors. When the body's resistance is lowered, the individual becomes susceptible to the infective organism.

Factors that may lower the body's resistance are:

1. Age (the very young or the very old)
2. Drugs (frequent or continuous use of antibiotics, cortisone, or steroids)
3. Immunosuppressive drugs (frequently used in cancer or in organ transplants)
4. Heavy irradiation (causes a breakdown in the body tissue and depresses the immune response)
5. Malnutrition
6. Chronic diseases (uremia, diabetes, cancer, nephrosis, leukemia)
7. Shock (lowers resistance due to the frequent metabolic interference of the disease and the eventual breakdown of important body functions)

Practice Question #8

Name four of the seven factors that may lower the body's resistance to infection.

Feedback

Check the input for Exercise #8 and review the seven factors listed there. If you have correctly identified four of them, you have answered the question.

Before turning to Page 14 to test your memory with a final quiz, study the chart on Page 2A for a review of what you've learned.

POST-TEST

1. Define the following terms:
   a) Epidemiology ____________________
   b) Epidemic ____________________
   c) Pandemic ____________________
   d) Endemic ____________________

2. When may an endemic disease become epidemic? ____________________

   ____

3. State the six factors involved in the infectious process, in sequence of involvement.
   a) ____________________
   b) ____________________
   c) ____________________
   d) ____________________
   e) ____________________
   f) ____________________

4. Explain the primary role of the infectious agent as related to the infectious process.

5. Define SOURCE or RESERVOIR as they relate to the infectious process. Give examples of inanimate sources.

6. Define PORTAL OF EXIT in relation to the infectious process. Give examples.

7. Define MODES OF TRANSMISSION in relation to the infectious process.
   Give examples of:
   a) Direct transfer (three types)

   ____

   ____

   ____

Give examples of:

b. Indirect transfer

____

____

c. Explain INTERMEDIARIES as related to involvement in the infectious process.

____

____

d. Give examples of VEHICLES as intermediaries.

____

____

e. Give examples of VECTORS as intermediaries.

____

____

f. What is meant by MECHANICAL means?____________________

g. What is meant by BIOLOGIC means?____________________

8. Define PORTAL OF ENTRY. Give examples of those relating to the infectious process.

9. Explain the term HOST in relation to the infectious process.

10. Name four factors that tend to lower the body's resistance to infection.

a)____

b)____

c)____

d)____

ANSWERS

1. Epidemiology - is the study of the occurrence and distribution of disease as it is prevalent in man.
   Epidemic - is a term applied to the occurrence of a disease in many people at the same time or in rapid succession; in one or more persons in an area where the disease had not previously been recognized; or in one or more persons where the disease (such as smallpox) had not been reported in at least 10 years.
   Pandemic - is when a disease is epidemic at the same time in many parts of of the world.
   Endemic - is a disease that is generally present in a given locality in a certain number of the population. Most infectious diseases are endemic in some locality and do not usually become epidemic, since the infectious agent is of ordinary virulence and most people in the environment have immunity.

2. An endemic disease may become epidemic if a considerable number of persons lack immunity or if the infectious agent suddenly becomes more virulent than usual.

3. The six factors are:
   a) The microbial or infectious agent that lives and multiplies
   b) The source or reservoir in which it develops
   c) Its escape through the portal of exit
   d) Its transmission by various modes
   e) Its entry into the new source through the appropriate portal of entry
   f) Its maturation and multiplication in the new source (a susceptible host)

4. The infectious agent must be sufficiently virulent to produce a disease state in man. The organism's secretions or excretions or the organism itself must invade the cell. Once this happens destruction of the cell or multiplication of the organism or both occur.
   Examples: Bacteria, protozoa, rickettsiae, fungi, viruses, helminths.

5. Source or reservoir is the environment, either human, animal or inanimate, in which the organism lives and multiplies. Examples of inanimate sources: soil, air, food, water, milk, feces, fomites (drinking glasses, silverware, toilet articles).

6. Portal of exit - is a place through which the agent may escape: nose, mouth, eyes, ears, genitals, broken skin, lesions, wounds, urinary or intestinal tracts, or before birth the placenta.

7. Modes of transmission - these are the methods by which the infective organism is transferred from one host or source to another. This is done by direct or indirect transmission or transfer.
   Direct transfer of organisms through actual physical contact such as veneral disease, kissing, sexual intercourse. These contacts permit body contact with secretions that are harboring the infective organism.
   Direct transfer through infectious droplets that are coughed or sneezed or coughed within short range of a susceptible host.
   Direct transfer by contaminated hands, especially the fecal-oral route.
   Example: hands contaminated with feces due to failure to wash hands after going to the toilet, then the hands are put into the mouth or handle food that is put into the mouth.
   Indirect transfer involves an intermediary on which the infective organism persists outside the reservoir or source until it is transferred to another host.

Intermediaries are:

(1) Vehicles - which may be water, milk, air, or fomites (drinking glasses, silverware, toilet articles)

(2) Vectors - mainly arthropods (such as insects) that transmit pathogenic organisms by either mechanical or biologic means.

  (a) Mechanical means - the infective organism may adhere to the insect's body and be carried from place to place (flies that light on excreta may fly from there to light on food)

  (b) Biologic - insects(such as mosquitos, lice, ticks) bite an infective host, then go to a susceptible host and bite it. It may also bite an infective host, wait for gestation period to pass and then deposit its excreta onto the susceptible host.

8. Portal of entry - is the place through which the infective organism enters the new host. These are usually the same as the portal of exit.

9. Host - must be susceptible before organisms are able to cause infection or disease. Host that are immune to the particular infection or disease will not be affected. A host may be a human or animal that harbors or nourishes another organism (parasite).

10. Factors that lower the body's resistance to infection are:

a) Age (very young or very old)
b) Drugs (frequent or continuous use of antibiotics or steroids)
c) Immunosuppresive drugs (frequently used in cancer or in organ transplants)
d) Heavy irradiation (causes breakdown in the body tissue and depresses the immune response)
e) Malnutrition
f) Chronic diseases (uremia, diabetes, leukemia)

HEALTH INSTRUCTION EXCHANGE
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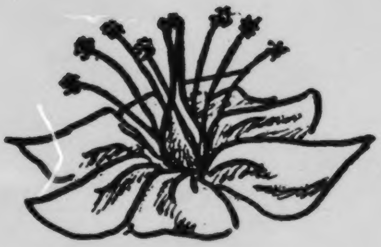
A PROJECT OF THE LEAGUE FOR INNOVATION IN THE COMMUNITY COLLEGE

GROWTH AND DEVELOPMENT OF A FLOWERING PLANT

By

S.W. Lavinger

Lauren Richardson, Illustrator



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TITLE: Growth and Development of a Flowering Plant

AUTHOR: S.W. Lavinger

INSTITUTION: Los Angeles Southwest College

INTENDED STUDENTS: Public; medical or dental office personnel

ESTIMATED WORKING TIME: 20 minutes

MATERIALS NEEDED: None

FIELD TEST VERSION

HEALTH INSTRUCTION EXCHANGE
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A PROJECT OF THE LEAGUE FOR INNOVATION IN THE COMMUNITY COLLEGE

INTRODUCTION

This program will introduce you to the major vegetative and reproductive plant parts and to the basic life processes and requirements necessary in the growth and development of a flowering plant. Hopefully knowledge of this information will increase your appreciation, care and maintenance of your house and garden plants.

OBJECTIVES OF UNIT

Overall Objective

The student shall be able to list the processes and requirements involved in the growth and development of a flowering plant.

Sub-Objectives

As a result of this program you will be able to:

1) Name and identify the vegetative portions of the plant: root, stem and leaf,

2) Name and identify the reproductive portions of the plant: flower, pistil, stamen, fruit and seed,

3) State the processes, requirements and environmental conditions necessary for vegetative plant growth,

4) State the processes, requirements and environmental conditions necessary for seed germination and seedling development.

PARTS OF THE PLANT

The parts of the plant can be classified into two general types, Vegetative plant parts and Reproductive plant parts.

The vegetative plant parts are involved in all growth processes not related to flowering and reproduction.

The reproductive plant parts are involved in plant reproduction, or the production of new plants similiar in form to the parent plant.

Practice Exercise

1. Name two types of plant parts.

   A. ____________________________

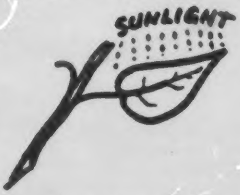
   B. ____________________________

2. Match the type of plant part to the process with which it is involved.

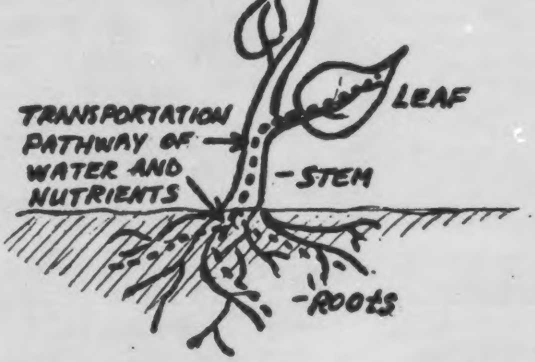
A. Vegetative	1. Growth processes not related to flowering
B. Reproductive	2. Production of new plants

The vegetative plant parts are the leaf, the stem and the root.

The leaf is the flat green part that catches sunlight to manufacture sugar.



The stem is the long rod-like part which provides support for the leaves and transports water and nutrients necessary for growth up from the roots to the leaves.

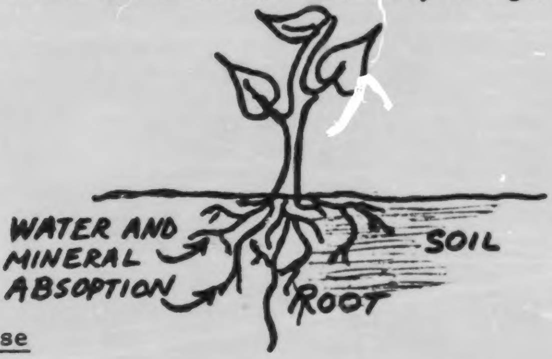


Answers

1. Reproductive
   Vegetative

2. A1 B2

The root of the fibrous underground part which anchors the plant in the soil and absorbs water and nutrients necessary for growth.



Practice Excercise

3. Name three vegetative plant parts.

1) ______________, 2) ____________________ 3) __________________

4. Match the vegetative plant part with its function.

A. Stem ________________________ 1. Manufacture of food

B. Leaf ________________________ 2. Transport of water & nutrients

C. Root ________________________ 3. Absorption of H_2O & minerals

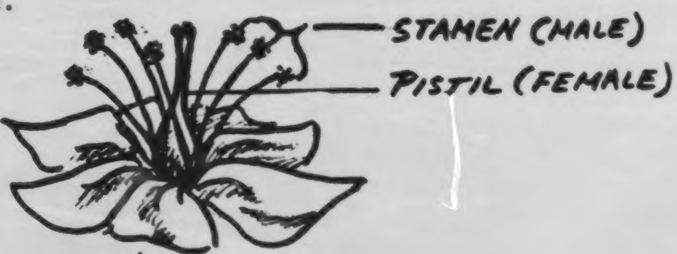
The reproductive plant parts are the flower, the fruit and the seed.

The flower is the colorful, fragrant part which attracts insects to visit the flower.

The flower houses both the male and female reproductive organs. The female reproductive organ is called the pistil. The male reproductive organ is called the stamen.

Insects aid the flower in reproduction by transporting the pollen from the stamen to the pistil, thereby carrying out pollination.

Pollination is the process by which the pollen from the stamen (male) is transfered to a receptive surface on the pistil (female) so that fertilization can take place.



Answers

3. root, leaf, stem

4. A2 B1 C3

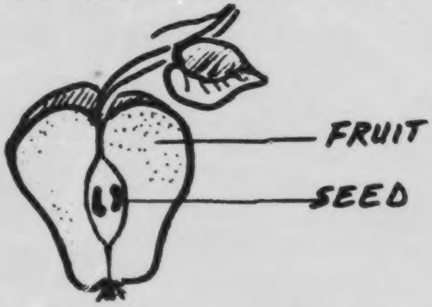
Practice Exercise

5. In the flower, the female reproductive organ is called the __________ and the male reproductive organ is called the __________

6. Insects aid the flower in reproduction by carrying out the process of __________

The fruit and the seed develop from the pistil after fertilization has occurred.

The fruit is the ripened pistil or outer fleshy covering around the seed which aids in dispersal of the seeds away from the parent plant.



Seeds of plants with fleshy fruits such as apples or berries are dispersed by animals. Animals eat the fruit but the seed contained in the fruit passes through their digestive system unharmed and is excreted by the animal in an area far away from the parent plant.

The seed is the nut-like part which contains the embryo of the new plant.

Practice Exercise

7. Name 3 reproductive plant parts

1) __________ 2) __________ 3) __________

8. Match the reproductive part with its description.

A. Flower
B. Fruit
C. Seed

1. Contains the embryo
2. Colorful fragrant part which attracts insects
3. Ripened pistil or outer covering, aids in seed dispersal

Answer

5. Pistil, Stamen; 6. Pollination; 7. Flower, Fruit, Seed 8. A2, B3, C1

CONDITIONS NECESSARY FOR VEGETATIVE PLANT GROWTH

Two processes are critically necessary for vegetative plant growth: photosynthesis and respiration.

Photosynthesis is the process by which plants combine the raw materials of CO_2, H_2O and sunlight in the presence of chlorophyll to manufacture sugar and O_2.

$$CO_2 + H_2O + \text{sunlight} \quad \overset{\text{chlorophyll}}{\qquad\qquad} \quad \text{Sugar} + O_2$$

Green leaves contain chlorophyll and are factories to make sugar for the plant.

CO_2 for photosynthesis is obtained by the plant from the atmosphere through small openings in the leaf surface called stomates. H_2O for photosynthesis is obtained by the plant from the soil through absorption by the roots. Sunlight energy for photosynthesis is trapped by chlorophyll, the green pigment in the leaf.

Practice Exercise

9. The process by which plants use sunlight energy to manufacture sugar is called ________________.

10. Name three raw materials necessary for photosynthesis.
________________, ____________________, ____________________

11. In what part of the plant does photosynthesis occur?

Answers

9. photosynthesis

10. CO_2, H_2O, sunlight

11. the leaf

Respiration is the process by which sugar is combined with O_2 thereby breaking it down to release energy

$$\text{Sugar} + O_2 \longrightarrow CO_2 + H_2O + \underline{\text{ENERGY}}$$

The raw materials of respiration are Sugar and $\underline{O_2}$

This energy released through respiration is needed by the plant in order to combine mineral nutrients with stored food products to form substances necessary for growth.

Mineral nutrients are picked up by the plant from the soil and enter the plant through the roots.

Practice Exercise

12. The process by which the plant uses sugar to obtain energy to form substances necessary for vegetative growth is called ____________.

13. Name two raw materials necessary for respiration.

____________ ________________

14. What substance is combined with the stored food products and the energy released through respiration to form other substances necessary for growth?

____

15. Name two processes necessary for vegetative plant growth.

________________ ________________

Answers

12. respiration

13. Sugar and O_2

14. mineral nutrients

15. respiration and photosynthesis

For maximum plant growth, plants need not only the raw materials of CO_2, H_2O, and mineral nutrients, but also proper environmental conditions for growth such as sunlight and a proper temperature.

Practice Exercise

16. For maximum growth, plants need the following raw materials ______________, ______________. ______________.

17. Two environmental conditions which are necessary for plant growth are ____________ and ______________.

CONDITIONS NECESSARY FOR SEEDLING DEVELOPMENT

Each typical seed consists essentially of a protective seed coat, some stored food, and an embryo.

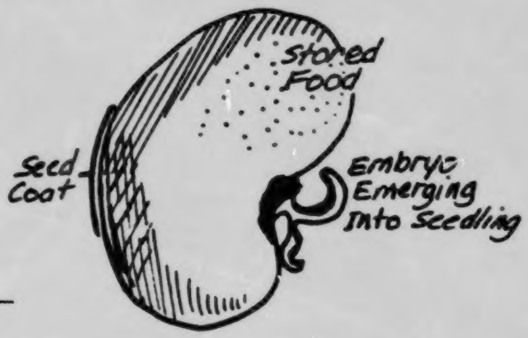
When a seed germinates the embryo grows, the seed coat bursts and the young plant emerges.

The emergent young plant is called a seedling.

Practice Exercise

18. Name 3 contents of a typical seed

____________ ____________ ____________



The seedling cannot manufacture its own food (photosynthesis) until it produces leaves. Therefore the early growth of the seedling is dependent on stored food in the seed.

The seedling through respiration releases energy stored in the food in order that it can be used to produce the leaves, stem and roots of the developing plant.

The requirements necessary for a maximum respiration rate and thereby necessary for seed germination and seedling development are O_2, water and a warm temperature.

Answers
16. CO_2, H_2O, minerals
17. sunlight and a proper temperature
18. seed coat, stored food, embryo

Practice Exercise

19. The process by which the seedling converts its stored food supply into the energy necessary to produce the leaves, stem and roots is called

______ ____

20. Name 3 requirements necessary for seedling development.

________ ________ ________

Answers

19. respiration
20. O_2, water, a warm temperature

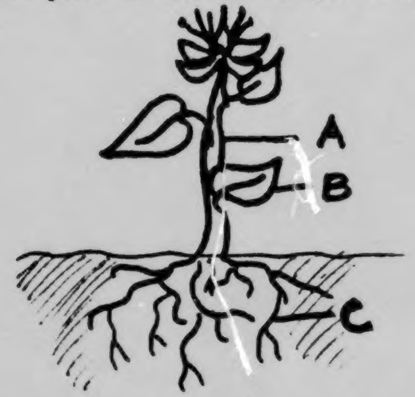
POST-TEST

1. Write the name of the vegetative plant part indicated in the drawing.

A. ____________________

B. ____________________

C. ____________________



2. Write the name of the reproductive plant part indicated in the drawing.

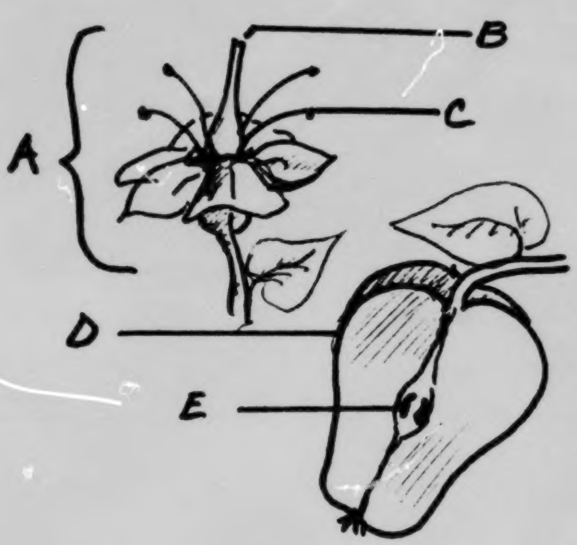
A. ____________________

B. ____________________

C. ____________________

D. ____________________

E. ____________________



3. Name two processes critically necessary for vegetative plant growth.

______________ ______________

4. The process by which plants use sunlight energy to manufacture sugar is called ________________.

5. The process by which the plant uses sugar to obtain energy to form substances necessary for vegetative growth is called ___________.

6. For maximum growth, plants need the following raw materials: _____, ___________ and ______________.

7. The process by which the seedling converts its stored food supply into the energy necessary to produce the leaves, stem and roots is called ______________.

8. Name 3 requirements necessary for seedling development. _______,

________________, _______________________.

KEY TO POST TEST

1. A. stem

   B. leaf

   C. root

2. A. flower

   B. pistil

   C. stamen

   D. fruit

   E seed

3. respiration and photosynthesis

4. photosynthesis

5. respiration

6. CO_2, H_2O, mineral nutrients

7. respiration

8. O_2, H_2O, warm temperature

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A PROJECT OF THE LEAGUE FOR INNOVATION IN THE COMMUNITY COLLEGE

PRINCIPLE OF ASEPSIS AS APPLIED BY THE VOCATIONAL NURSE STUDENT IN THE O.R.

by

Barbara L. Turk

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TITLE OF PACKAGE: Principle of Asepsis as Applied by the Vocational Nurse Student in the O.R.

AUTHOR: Barbara L. Turk

INSTITUTION: Long Beach Community College,
Long Beach, Calif.

INTENDED STUDENTS: Vocational nursing

ESTIMATED WORKING TIME: 30 Minutes

MATERIALS NEEDED: None

FIELD TEST COPY

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INTRODUCTION

As a vocational nurse student, you must prepare yourself to function safely in the operating room. (O.R.)

One of the basic concepts that you must understand and apply with integrity is meticulous aseptic technique.

Your understanding and application of the principles of asepsis is a shared responsibility for all concerned with the welfare of the patient.

Your ability to apply the principles of asepsis in an appropriate manner will be one of the first building blocks toward the practice of safe nursing care throughout your nursing career.

CLEANLINESS IS NEXT TO GODLINESS
OPERATING ROOM

OBJECTIVES OF THE UNIT

Upon completion of this package, you will be able to differentiate between surgical and medical asepsis. You will:

1) Define asepsis in broad terminology as it relates to you in O.R.
2) Define medical asepsis as you observe it in O.R.
3) Define surgical asepsis as you observe it in O.R.
4) List two activities that demonstrate medical asepsis.
5) List two activities that demonstrate surgical asepsis.
6) Identify two methods by which the student may contaminate a sterile field.

PRACTICE EXERCISE #1

Asepsis is an all-encompassing term referring to those conditions free of germs. Within this broad term the student will recognize two conditions of asepsis which demand different nursing conditions.

The first condition is medical asepsis, which indicates something is clean or free from dangerous microorganisms. Clean hands or fingernails are examples of medical asepsis.

The second condition is surgical asepsis, which indicates there is freedom from all microorganisms. Examples of this would be a sterile surgical pack or package of gloves.

Question 1

Before stating my question I wish to create a situation for you from which the questions will be drawn.

As you approach the O.R., you see one nurse washing her hands; further on, a gowned nurse is using closed technique to don gloves, the opened sterile gown and glove packages beside her.

Fill in the missing words:

1) As an act in itself, the first nurse's handwashing indicates ________________ aspsis.

2) The closed gloving and sterile packaging indicate ____________ asepsis.

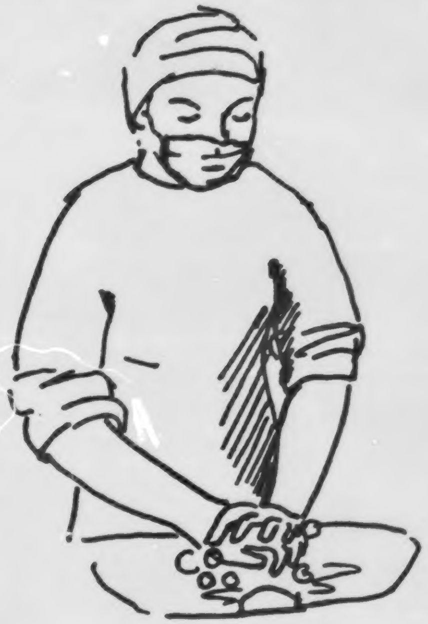
Practice Exercise # 1 (Cont.)

Answer

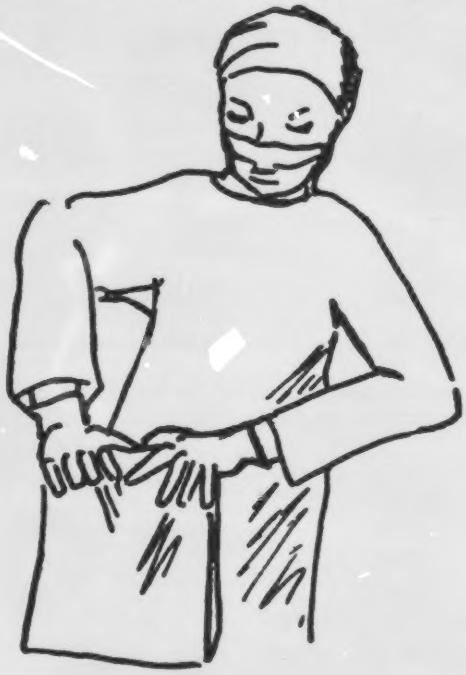
The missing word for question 1) is medical; for question 2), surgical.

You have the two terms straight if you recognized that clean hands can never be free from all microorganisms. So ..... medical asepsis abounds. If you identified that the opened sterile gown package is consistent with surgical asepsis, you may go on to the next lesson. If you have not accomplished this. please return to the previous lesson for a review.

MEDICAL ASEPSIS



SURGICAL ASEPSIS



PRACTICE EXERCISE # 2

Two types of asepsis were described in the first exercise. Now you should recognize that you will be applying the principles of either surgical or medical asepsis in the clinical setting. I would like to introduce at this time some new information that you must remember when practicing any type of asepsis.

Each type of asepsis requires a different technique from the student. When you are using surgical technique, you are using sterile technique. When you are performing medical asepsis, you are using clean technique.

Two common examples of medical aseptic technique would be handwashing and placing clean linen on the operating room table for the patient.

Two common examples of surgical aseptic technique would be the opening of a sterile package and closed gloving.

Techniques used for medical and surgical asepsis will be introduced as procedures in subsequent packages.

Question 2

You know that two conditions of asepsis exist in the operating room. One is surgical asepsis and the other medical asepsis.

Fill in the missing words:

1) Placing clean linen on the operating table is an example of ________________ aseptic technique.

2) Closed gloving is an example of ______________ aseptic technique.

Practice Exercise #2 (Cont.)

Answer

The missing word for question 1) is medical; for question 2), surgical.

Your correct answers differentiated between the two aseptic techniques.

In a subsequent unit you'll learn more about the procedures by which medical and surgical asepsis are accomplished; now the distinction is important.

PRACTICE EXERCISE #3

In the O.R., your own 10 fingers and your nasopharynx tract can be prime contributors to the contamination of the sterile field. Common ways that students contaminate themselves in the surgical field include:

1) Entering O.R. without a mask.
2) Not changing mask after it becomes wet.
3) Touching a sterile field with a hole in gloved hand.
4) Touching the sterile field with an ungloved hand.
5) Sneezing over a sterile field.

QUESTION 3

In the list of seven items below, there are only two statements that indicate that medical or surgical asepsis has NOT been broken. Without looking back to the last paragraph, see if you can check the two items that indicate good aseptic technique.

1) Entering O.R. without a mask.
2) Not changing mask after it becomes wet.
3) Moved back to back with another nurse in the operating room.
4) Did not pick up anything from the floor to be used in the sterile field.
5) Touching a sterile field with a hole in gloved hand.
6) Touching the sterile field with an ungloved hand.
7) Sneezing over a sterile field.

ANSWER

Good! You have just been reading a list of the most common ways students contaminate themselves in the surgical field, but you were able to pick out the two ways that a student practices good technique. Good technique is one of the best ways to stay happy while a student in the operating room. If you selected items #3 and #4, you may pass on to the next lesson with a smile on your face--realizing that your own ten fingers and nasopharynx are prime contributors to contamination of the sterile field by all students.

PRACTICE EXERCISE #4

When you enter the operating room for the first time, you should recognize that the scrub nurse and circulating nurse are working in the same room, using varying degrees of medical and surgical aseptic techniques. You also note that their duties differ from one another. With these different duties go different techniques.

It is safe to say that the gowned and gloved scrub nurse is sterile and she is practicing surgical aseptic technique.

It is also accurate to say that the circulating nurse may be practicing both medical and surgical aseptic technique. The circulating nurse is not a sterile person. If she touches or has anything to do with someone or something she must remember that her ten fingers and nasopharynx are only in a clean state.

Question 4

Decide which duties described below require surgical (sterile) technique and which require medical (clean) technique. Then check the appropriate column for each duty listed.

DUTIES	MEDICAL ASEPSIS	SURGICAL ASEPSIS
1. Circulating nurse gowns scrub nurse.	______	______
2. Scrub nurse gowning physician.	______	______
3. Circulating nurse putting on scrub dress.	______	______
4. Circulating nurse puts on mask.	______	______
5. Scrub nurse gloving physician.	______	______

Practice Exercise # 4 (Cont.)

Answers

The correct answers are:

	MEDICAL ASEPSIS	SURGICAL ASEPSIS
1.		X
2.		X
3.	X	
4.	X	
5.		X

If your answers are correct, you are now ready for the POST-TEST questions which will sum up your understanding of the information covered in the preceding four practice exercises.

POST-TEST

1. Asepsis is a term referring to:

   a) Surgical asepsis only

   b) Medical asepsis only

   c) Both medical and surgical asepsis

   d) Anesthesia

2. Medical asepsis refers to:

   a) Clean

   b) Dirty

   c) Unclean

   d) Sterile

3. Surgical asepsis refers to equipment free from:

   a) Dirt

   b) Some microorganisms

   c) All microorganisms

   d) Blood

4. The two most common ways of contaminating a sterile field by a student are:

   a) Fingers and nasopharynx tract

   b) Finger and gut

   c) Respiratory tract and ears

   d) Intestinal tract and nose

5. Mark S for the activities that demonstrate surgical asepsis and M for those that demonstrate medical asepsis:

   a) Closed gloving

   b) Handwashing

   c) Placing linen on operating table

   d) Opening sterile gown package.

ANSWERS TO POST-TEST

1. c - (both medical and surgical asepsis)

2. a - (clean)

3. c - (all microorganisma)

4. a - (fingers and nasopharynx tract)

5. a. S
    b. M
    c. M
    d. S

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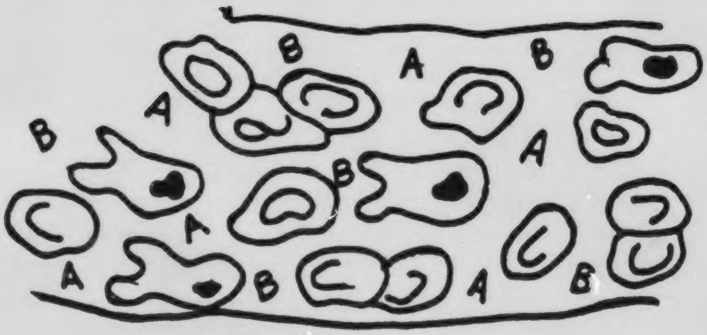
TYPES OF BLOOD THAT RECIPIENTS CAN RECEIVE FROM DONORS

by

A. Louise Jones



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TITLE OF PACKAGE:	Types of Blood that Recipients can Receive from Donors
AUTHOR:	A. Louise Jones
INSTITUTION:	Phoenix Community College
INTENDED STUDENTS:	Nursing
ESTIMATED WORKING TIME:	30 minutes
MATERIALS NEEDED:	None
REVISED:	June 1, 1977

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OBJECTIVES OF UNIT

Overall Objective

Given a patient with a specific blood type, state what blood type he can receive.

Sub-Objectives

1. Name the four major blood groups or types and the name of the antigen each contains.
2. Name the antibodies found in each of the four major blood groups or types.
3. Describe where antigens and antibodies are found in the blood.
4. State the reason blood never contains both an antigen and its antagonistic antibody.
5. State/identify the term Rh+.
6. State/identify the term Rh-.
7. List/identify the antigens and antibodies found in the following blood types: A+, A-, B+, B-, AB+, AB-, O+, O-.

INTRODUCTION

At the time blood transfusions were first attempted it was difficult to know if they would be successful or not. The unsuccessful transfusions were sometimes fatal. Through continued research and scientific discovery, it was found that bloods of different persons have different antigens and antibodies and this seemed to be the key to the success of transfusions. As a result of this information precautions can now be taken ahead of time to determine if the person who gives blood (the donor) has antigens which are compatible to the antibodies of the person receiving the blood (the recipient).

By the time you have completed this unit you should be able to state the type of blood a recipient can receive from a donor, so that the antibodies and antigens of both are compatible with each other.

If one individual receives an incompatible type of blood from another individual the results can be dangerous to the recipient. As a nurse, you should know about these blood types so you can be certain the patient you care for does not receive the wrong type of blood.

The four major Blood Types (or Blood Groups) of clinical importance are: A, B, AB, and O. (Although Blood Types will be Rh+ or Rh-, I don't want you to concern yourself with this now as it will be explained later in the lesson.)

Blood Types are based upon the type of antigen attached to the Red Blood cell. These antigens are Antigen A and Antigen B. Persons who are Type A have A Antigen attached to their Red Blood Cell and those who are Type B have B Antigen attached to their Red Blood Cell. Those person who are Type AB have both A Antigen and B Antigen attached to their Red Blood Cells, while persons who are Type O do not have antigens attached to their Red Blood Cells.

Practice Question #1

List each of the four Major Blood Types and the Antigen each Type contains:

1)

2)

3)

4)

Feedback

You were absolutely correct if you listed:

Type A - Antigen A
Type B - Antigen B
Type AB - Antigen A, Antigen B
Type O - No Antigens

Now that you know about the Antigens in each Blood Type, let's look at the antibodies each Blood Type contains.

Blood types are based not only on their antigens, but also on their antibodies, called anti-A antibody and anti-B antibody. REMEMBER blood never contains both an antigen and its antagonistic antibody. For example, Type A (Antigen A) DOES NOT contain anti-A antibodies. INSTEAD, persons with Type A blood have anti-B antibodies while those who are Type B have anti-A antibodies. On the other hand, persons with Type AB blood do not have any antibodies at all while persons with Type O have both anti-A and anti-B antibodies.

Practice Question #2

Name four Major Blood Types (Groups) and list the name of the antibody found in each group:

1)
2)
3)
4)

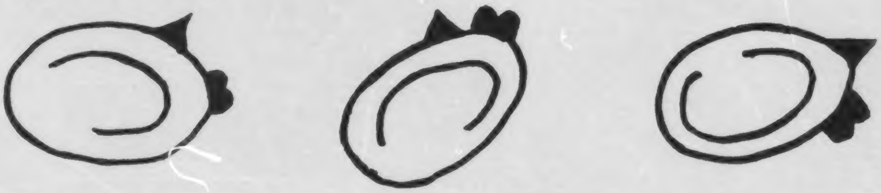
Feedback

If you listed the following, you're doing right well, as this concept is a little more difficult to remember.

Type A	anti-B antibody
Type B	anti-A antibody
Type AB	no antibodies
Type O	anti-A antibodies anti-B antibodies

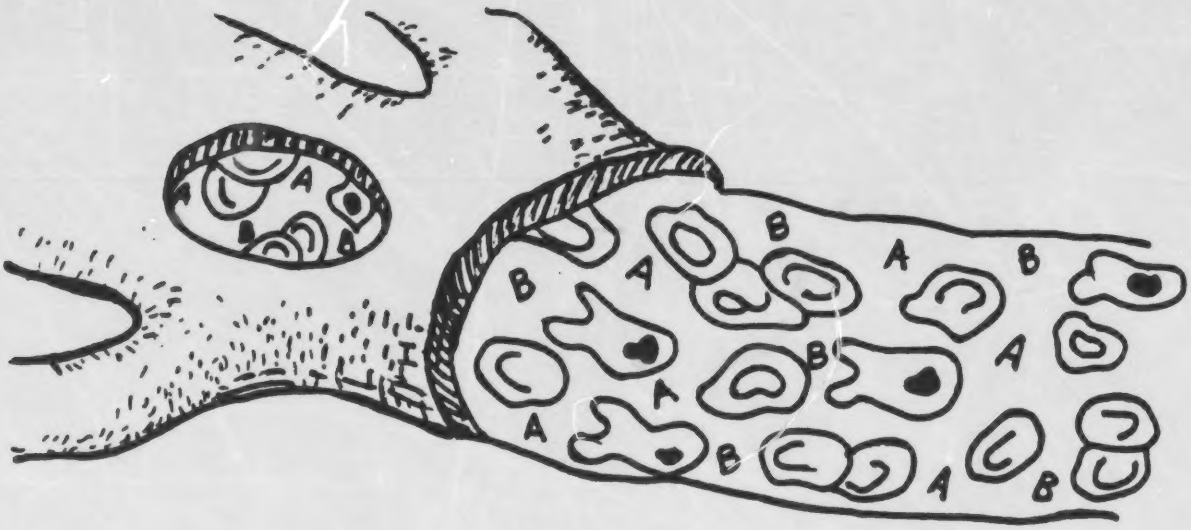
You now know that all blood contains antigens and antibodies. To understand how reactions occur you must know where these antigens and antibodies are located within the blood.

Let's first look at some Red Blood Cells (RBC) floating around in the blood serum.



The antigens are attached to the RBC. In the diagram the ▲ and B represent the ANTIGEN.

To see where antibodies are located, look into this blood vessel where you see numerous blood cells and other substances floating in the serum.



The symbol A and B represent antibodies floating within the serum.

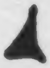
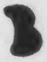
Practice Question #3

State the location of the antigens and the antibodies that are located in the blood.

Feedback

Antigens are attached to or within the Red Blood Cell (RBC).

Antibodies are found floating within the serum.

YOU'LL deserve a bonus if you figured that the  and  are A antigen and B Antigen, respectively.

AND a second bonus if you figured the A and B were anti-A antibodies and anti-B antibodies.

Let's review the presence of the antigens and antibodies in the ABO Blood Groups (Types); then look at the reason a person's blood does not contain both an antigen and its antagonistic antibody.

1. A person's blood type is based upon the type of antigen attached to his red blood cell. The exception to this is Type O Blood which does not have any antigens attached to its red blood cell.

2. When a person does not have an A antigen on his red blood cell, antibodies known as "anti-A" develop in his plasma. In the same manner, a person who does not have a B antigen on his red blood cell develops "Anti-B" antibodies in his plasma. To summarize, persons with Type A blood have "anti-B" antibodies; those with B type have "anti-A" antibodies, those with AB type have no antibodies in their serum and those with O type blood have both "anti-A" and "anti-B" antibodies.

3. "Anti-A" antibodies are capable of reacting with type A antigen to cause agglutination (clumping) of the red blood cell to which the antigen is attached. Similarly, "anti-B" antibodies are capable of reacting with type B antigen to cause agglutination of the red blood cell to which the antigen is attached.

To prevent reaction and complete destruction of an individual's own blood a person never has both an antigen and its antagonistic antibody.

Practice Question #4

4a. List the antigen and antibody found in the following blood types:

Type	Antigen	Antibody
A		
B		
AB		
O		

4b. Describe why a person does not have both an antigen and its antagonistic antibody in his blood.

Feedback

The following chart summarizes the answer to 4a.

Type	Antigen	Antibody
A	A	"anti-B"
B	B	"anti-A"
AB	A & B	None
O	None	"anti-A" and "anti-B"

In 4b, you should answer that an antibody could cause agglutination of a red blood cell that has an antagonistic antigen attached to it.

Now it's time to look at Rh. The Rh blood groups are of equal importance to the ABO groups just studied. The Rh blood groups are determined by a series of closely linked genes in various combinations. These genes exist essentially as antigens. The D factor is the strongest antigen and of the greatest significance clinically. It is the presence or absence of this antigen that determines if a person is Rh+ or Rh-.

A person who is Rh+ (whose red blood cells contain the Rh or D antigen) never carry anti-Rh (anti-D) antibodies within their serum. Persons who are Rh- (do not have D antigen) do, however, develop anti-Rh antibodies in their serum gradually after exposure to Rh+. This occurs when an Rh- person is transfused with Rh+ blood.

Practice Question #5

5a. Would a person whose red blood cells carry D antigen be Rh+ or Rh-?

5b. Describe how an Rh- person can develop anti-Rh antibodies.

Feedback

I hope you put Rh+ for 5a. Remember, the D antigen is often called the Rh antigen and it is contained on the red blood cell.

5b. The Rh- person develops the anti-Rh antibodies in his serum gradually after exposure to Rh+, such as would occur after being transfused with Rh+ blood.

It's time to combine the information you've gained regarding ABO and Rh blood groups. The antigen determines the blood type and the Rh status of an individual. For example: if a person is type A, he has an A antigen attached to his red blood cell. In addition, if he is Rh+, he carries the Rh (or D) antigen on his red blood cell. You would identify this person's blood as A+. If a person is B+, his red blood cell has both the B antigen and the Rh antigen. AB+ Blood has the A antigen, B antigen and the Rh antigen on its red blood cells. and lastly O+ blood contains only the Rh+ antigen on its red blood cell.

If a person is Rh-, his red blood cell does not contain the Rh (or D) antigen. Thus, if a person is A-, he has only the A antigen attached to his red blood cell. An individual who is B- has only the B antigen on his red blood cell; one who is O- does not have any antigens attached to his red blood cell.

You should also keep in mind that:

Type A blood has anti-B antibodies in the serum.

Type B blood has anti-A antibodies in the serum.

Type O blood has anti-A and anti-B antibodies in the serum.

Type AB blood does not have antibodies in the serum.

Practice Question #6

6a. Name the antigens attached to the red blood cell of a person who is O+

6b. Name the antigens attached to the red blood cell of a person who is A- and the antibodies contained in the serum.

6c. Name the antigen attached to the red blood cell of a person who is AB+.

Feedback

Hopefully, your answers are:

6a. Rh (or D) antigen

6b. A antigen; anti-B antibodies

6c. A antigen, B antigen, Rh antigen

Persons who give blood are referred to as donors and persons who receive blood are called recipients. It is imperative that the donor and recipient blood belong to compatible blood groups. This means that antibodies in the recipient will not clump the donor's red blood cells (which contain antigens) as they enter the recipient's blood stream. If a donor's antigen comes in contact with the recipient's antagonistic antibody, a transfusion reaction occurs.

Persons with 0 type blood are called universal donors because their red blood cells do not have antigens attached to them and thus could not be destroyed in an antigen-antibody reaction..

Persons with type AB blood are called universal recipients because their serum does not contain antibodies that could destroy donors' red blood cells during a transfusion.

Persons with identical blood types are also considered compatible to each other.

Remember it is the donor's antigen (on red blood cells) that must be compatible with the recipient antibodies (serum). The following chart summarizes which of the donor's blood would be compatible to the recipient's blood in a transfusion.

RECIPIENT	can receive from	DONORS
A		A or 0
B		B or 0
AB		AB, A, B, or 0
0		0 only

The donor whose red blood cells has an Rh antigen (or D antigen) attached to it must also be compatible to the recipient's blood. However, a donor with Rh- blood (red blood cell does not contain an Rh or D antigen) can give blood to either an Rh- or Rh+ recipient.

Thus, an A+ recipient can receive blood from A+, A-, O+, and O- donors, but the A- recipient can receive blood only from A- and O- donor.

Practice Question #7

7a. An AB+ recipient can receive blood from which donor type?

7b. An O- can receive blood from which donor type?

7c. An A- can receive blood from which donor types?

Feedback

The answer to 7a is an AB+ recipient can receive blood from the following donors: A-, A+, B-, B+, O-, O+, AB-, AB+.

7b. An O- recipient can receive blood from donors with O- blood.

7c. An A- recipient can receive blood from donors with A- and O- blood types.

POST-TEST

1. Complete the following chart by listing the four major Blood Types (Groups) and indicating the antigens and/or antibodies contained in each Type.

Blood Type	Antigen	Antibody

2. Antibodies found the blood are located in ____________________.

3. Antigens found in the blood are located ____________________.

4. State one reason a person's blood does not contain both an antigen and its antagonistic antibody.

____

5. A person whose red blood cell contains D antigen is Rh ________, while
(5a) (+or-)
a person who does not have a D antigen on his red blood cell is
Rh ________.
(5b) (+or-)

6. In the following blood types, list all the antigens attached to each red blood cell, and the antibodies located within the serum:

Post Test (Continued)

BLOOD TYPE	ANTIGEN	ANTIBODY
A+		
B-		
AB-		
O+		
AB+		

7. For each of the following recipients, list the type of donor blood which is compatible.

RECIPIENT	DONOR
A-	
B+	
AB+	
O+	

POST TEST KEY

1.

Blood Type	Antigen	Antibody
A	A	Anti-B
B	B	Anti-A
AB	A, B	None
0	None	Anti-A Anti-B

2. The serum

3. Attached to or on the RBC

4. The antibody would cause clumping of red blood cell which has an antagonistic antigen attached.

5. 5a Rh+

   5b Rh-

6.

Blood Type	Antigen	Antibody
A+	A, Rh	Anti-B
B-	B	Anti-A
AB-	A, B	None
0+	Rh	Anti-A, Anti-B
AB+	A, B, Rh	None

7.

Recipient	Donor
A-	A-, 0-
B+	B-, B+, 0-, 0+
AB+	A-. A+, B-, B+, AB-, AB+, 0-, 0+
0+	0-, 0+

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A PROJECT OF THE LEAGUE FOR INNOVATION IN THE COMMUNITY COLLEGE

LAB VALUES IN ACID-BASE IMBALANCES

by

Betty K. Grayson, M.S., R.N.

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TITLE OF PACKAGE: Lab Values in Acid-Base Imbalances

AUTHOR: Betty K. Grayson

INSTITUTION: West Valley College
Saratoga, California

INTENDED STUDENTS: R.N. in Continuing Education or R.N. Refresher

ESTIMATED WORKING TIME: One hour

MATERIALS NEEDED: (Optional) Trainex film: "Acid-Base Balance: Compensation of Imbalances"

REVISED: September 1, 1977

Prerequisite Knowlege:

1. Basic knowledge of principles of acid-base balance.
2. Definitions:
   - pH
   - pCO_2
   - HCO_3^-
   - acid
   - base (alkali)
   - acidosis
   - alkalosis
   - arterial blood gases

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INTRODUCTION

The purpose of this module is to give you the opportunity to practice applying blood gas values to patient situations. Before taking this unit, you should have a basic understanding of acid-base balance in the body, and the importance of maintaining a proper ratio of acids and bases in the body.

Overall Objective

Given the pH, pCO_2, and HCO_3- arterial blood gas values of a hypothetical patient, you will be able to determine his acid-base balance.

Sub-Objectives

List the normal arterial blood values for: pH, pCO_2, HCO_3-.

Given a set of the above three lab values, decide which needs to be looked at first to determine the patient's acid-base status.

Identify the four types of acid-base imbalances which can occur.

Identify the relationship of pCO_2 values to respiratory imbalances.

Identify the relationship of HCO_3- values to metabolic imbalances.

Express a willingness to incorporate the evaluation of lab values into planning patient care.

We are going to be studying the relationship of selected arterial blood gas (ABG) lab values to acid-base balance. Changes in the ABG values are indicative of changes in the patient's acid-base balance. In order to determine whether a patient's lab values are altered from the normal, it is essential to know what his values should be. The normal pH is 7.4, (range of 7.35 - 7.45); normal pCO_2 is 40mm Hg. (range of 35 - 45); and normal HCO_3^- is 24m Eq. (range of 22 - 26).

Practice Question #1

Now tell me again. The normal arterial blood gas value

for pH is?_______________

for pCO_2 is?_______________

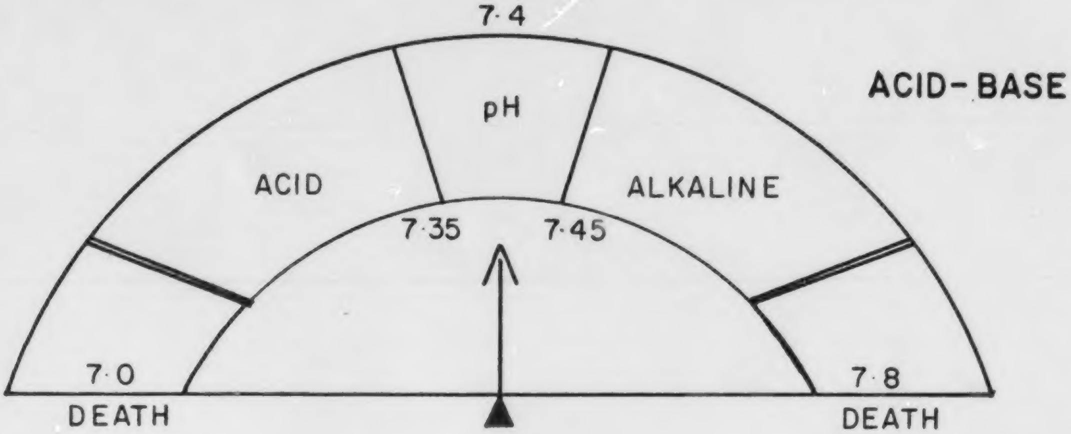
for HCO_3^- is?_______________

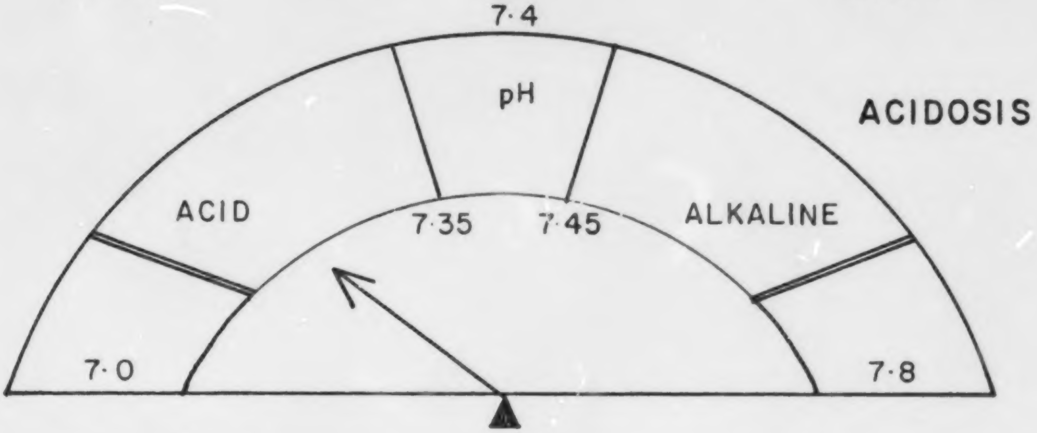
Answer

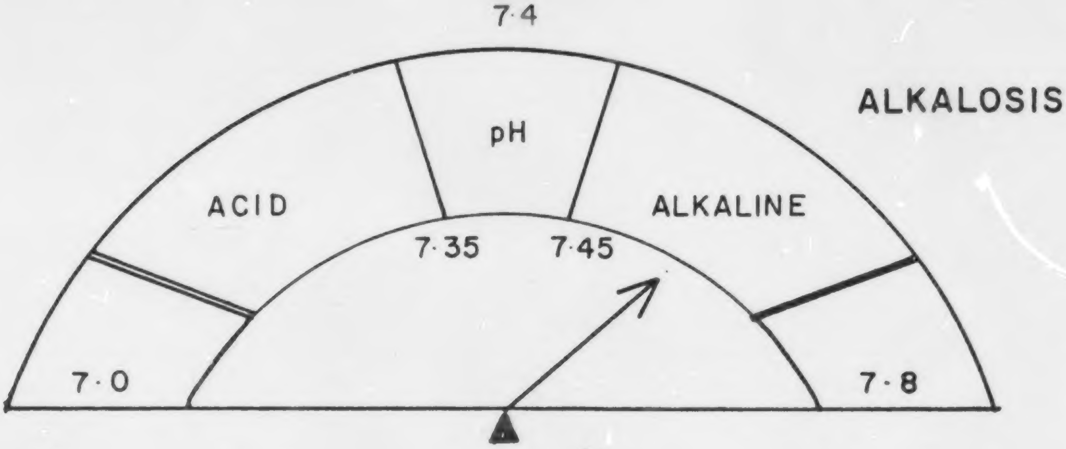
You are correct. Normal pH is 7.4; pCO_2 is 40mm Hg; and HCO_3^- is 24mm Eq. It is important for you to remember these three values in order to succeed at the remaining exercises.

PRACTICE EXERCISE #2

pH is the only way to tell if a body is too acid or too alkaline. Low pH (below 7.35) indicates an acid state, and high pH (above 7.45) indicates an alkaline state. This may be visualized by the following scales:


7·4
ACID-BASE
pH
ACID
ALKALINE
7·35
7·45
7·0
7·8
DEATH
DEATH


7·4
pH
ACIDOSIS
ACID
ALKALINE
7·35
7·45
7·0
7·8


7·4
ALKALOSIS
pH
ACID
ALKALINE
7·35
7·45
7·0
7·8

Before determining whether the cause of the imbalance is respiratory or non-respiratory (metabolic), you must first determine what the imbalance is. To decide what the imbalance is, determine whether the pH is low (acidosis) or high (alkalosis).

Practice Question #2

Let's practice this for a few minutes.

1) Again, normal pH is:______________________________.

2) A patient who is in acidosis will have a pH________________7.4.
(below, above)

3) A patient who is in alkalosis will have a pH________________7.4.
(below, above)

Now, match the following set of items:

________4) pH = 7.48

________5) pH = 7.56

________6) pH = 7.25

________7) pH = 7.30

a = acidosis

b = alkalosis

Answer

1) 7.4

2) below

3) above

4) b

5) b

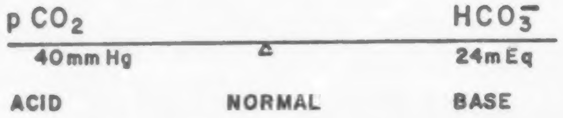
6) a

7) a

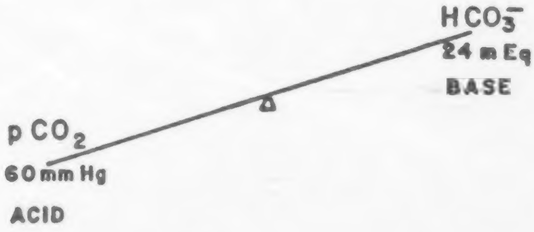
If you have answered these with 100% accuracy, you are ready to move to the next exercise. If you had trouble with this, perhaps re-reading the material would be helpful.

Once you have determined whether the patient is in acidosis or alkalosis, the next step is to find out whether the cause of the problem is a respiratory condition or a non-respiratory (metabolic) problem. As you know, the lungs take in O_2 and blow off CO_2. If the lungs have a problem (for example, pneumonia or emphysema) they will not blow off as much CO_2 as they should, and it will build up in the body. The CO_2 in the body will then combine with water to form carbonic acid ($CO_2 + H_2O \rightarrow H_2CO_3$). It is not necessary for you to know this formula, but you should remember that an increase in CO_2 (expressed as pCO_2) will cause an increase of acids in the body. And an increase of acids in the body will cause acidosis. Think of the balance like a teeter-totter. If additional weight is added to either side, the balance will be upset.

① NORMAL ACID-BASE BALANCE



② RESPIRATORY ACIDOSIS



Let's look at a set of lab values to further demonstrate this:

Mr. Smith's pH is 7.3, his pCO_2 is 60, and his HCO_3^- remains at 24.

Looking at his pH, we know he is in acidosis. We now look at the pCO_2 and HCO_3^- to find out why. Immediately we see that he is retaining CO_2 (an acid); so we conclude the cause of the acidosis is his lungs. From this we know that Mr. Smith is in respiratory acidosis.

Now you try one.

Practice Question #3

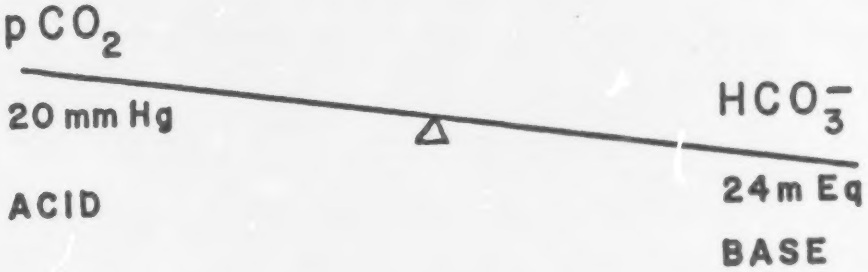
Mrs. Lark has a pH of 7.34, a pCO_2 of 58, and a HCO_3- of 24. She is in a state of_________________________.

Answer

You are correct. She is in a state of respiratory acidosis.

What if, however, instead of retaining CO_2, the lungs are blowing off excessive amounts of it (as happens when a patient hyperventilates). The body will then be losing acids. If the body loses too many acids, it will become alkaline because again, its balance of acids and bases will be off. It will not have enough acids to balance off the bases it has.

③ RESPIRATORY ALKALOSIS



This patient will go into respiratory alkalosis: alkalosis, because the body will have fewer acids than bases, and respiratory, because it is the lungs which have caused the imbalance to occur.

Practice Question #4a

Let's look at an example. Mr. James comes into the emergency room breathing very shallow and rapidly. You suspect he is probably in respiratory alkalosis. To confirm your suspicion, you look at his arterial blood gas values. What you expect to find is:

1) a pH of
   a) 7.4
   b) above 7.45
   c) below 7.35

2) a pCO_2 of
   a) 40 mm Hg
   b) more than 45mm Hg
   c) less than 35mm Hg

Answer

If you answered (b) for #1 and (c) for #2, you are correct.

Practice Question #4b

If you missed that question, try this one:

Mrs. Green comes into the hospital with the following blood gas values:

pH	7.5
pCO_2	26
HCO_3^-	24

First, decide whether she is in acidosis or alkalosis by looking at the pH. She is in ____________________.

Now, is the cause respiratory? (if "yes", the pCO_2 will be down; if "no", the pCO_2 will not be down.) The answer is ____________.

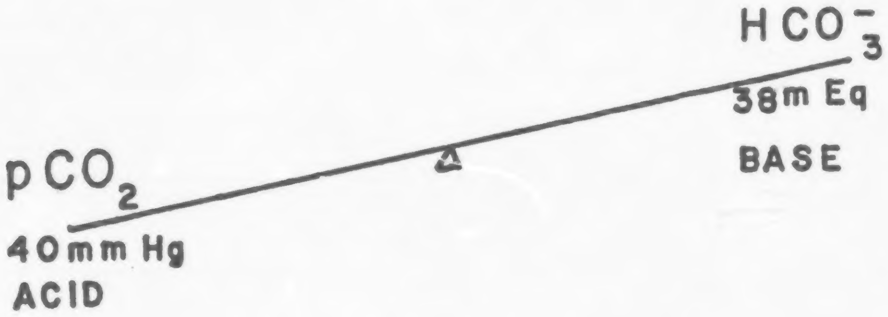
Mrs. Green is in a state of ____________ ______________.

Answer

You are correct again. Mrs. Green is in respiratory alkalosis.

Just as pCO_2 levels determine the respiratory causes of acid-base balances, so does HCO_3^- determine metabolic causes of acid-base balance. As you already know, HCO_3^- is a base or alkaline substance. The level of bicarb (HCO_3^-) in the body is controlled by the kidneys or the body's metabolism - hence, the terms "metabolic". Since HCO_3^- is a base, an increase of bicarb in the body causes the individual to go into alkalosis. This alkalosis is a metabolic (non-respiratory) alkalosis.

④ METABOLIC ALKALOSIS



Let's look at some examples

Mr. Green's blood gases are:

pH	7.56
pCO_2	40mm Hg
HCO_3^-	36mm Eq

We know that Mr. Green is in alkalosis because his pH is higher than normal. His alkalosis is not caused by the lungs because his pCO_2 is normal. Is it caused by the kidneys? His HCO_3^- is elevated. His kidneys have not been properly excreting it.

Practice Question #5

Now, you try one. Mr. Harding has a history of an ulcer. He takes soda bicarb to relieve his pain and burning. Mr. Harding's arterial blood gases read:

pH	7.6
pCO_2	50
HCO_3^-	42

1) Mr. Harding is in
   a) acidosis
   b) alkalosis

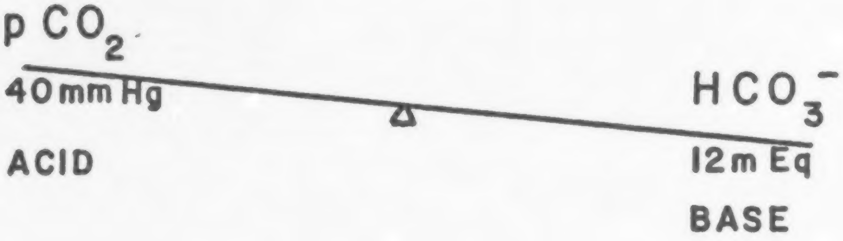
2) The cause is
   a) respiratory
   b) metabolic

Answer

If you answered (b) for #1 and (b) for #2, congratulations! If you need more practice, view the Trainex film, "Acid-Base Balance: Compensation of Imbalances". Did the increase in Mr. Harding's pCO_2 throw you off? Don't let it. You looked at the pH first, and decided that he is in alkalosis. Two things can cause alkalosis. One is a decrease in pCO_2 (respiratory) and the other is an increase in HCO_3^- (metabolic). Mr. Harding's pCO_2 is up, not down. This rise in pCO_2 is an attempt to compensate for the body's metabolic problem; not the cause of the problem.

We have talked about respiratory acidosis and alkalosis, and metabolic alkalosis. The imbalance not yet mentioned is metabolic acidosis. Essentially, what causes metabolic acidosis is a loss of bicarb (HCO_3-) from the body.

⑤ METABOLIC ACIDOSIS



This can happen in several ways, but will always result in the same lab value - a HCO_3- level of below 24m Eq.

Practice Question #6

How about some examples:

1) pH = 7.3	2) pH = 7.25
$pCO_2 = 40$	$pCO_2 = 30$
$HCO_3- = 10$	$HCO_3- = 8$
Diagnosis: ______________	Diagnosis: ______________
______________	______________

Answer

If you answered metabolic acidosis for both, you are correct again. Now, you have accomplished all of the objectives for this course. Contratulations for mastering what many consider to be a difficult subject!

Now, let's try mixing examples to challenge your ability. Just remember to look at the pH first to determine the patient's status. Then look for the cause. Rarely does only the pCO_2 or only the HCO_3^- change when the pH is off. But there is only one combination of changes occurring in each of the conditions. Maybe the following diagram will clarify this for you.

Acidosis: ↓ pH
↑ pCO_2 - Respiratory
↓ HCO_3^- - Metabolic

Alkalosis: ↑ pH
↓ pCO_2 - Respiratory
↑ HCO_3^- - Metabolic

The Trainex film which accompanies this package has other good ways of visualizing this concept. If you have the time and the interest, it may be helpful for you to look at it.

Practice Question #7

Case Studies: Diagnose each of the following.

1) pH = 7.3
pCO_2 = 60
HCO_3^- = 26

2) pH = 7.3
pCO_2 = 26
HCO_3^- = 8

3) pH = 7.56
pCO_2 = 60
HCO_3^- = 48

4) pH = 7.60
pCO_2 = 20
HCO_3^- = 16

Answer

1) respiratory acidosis

2) metabolic acidosis

3) metabolic alkalosis

4) respiratory alkalosis

If you've answered all of these correctly, you are ready for the post test. If you had a problem, go back and look at the values again. Did you remember the normal values? Did you look at the pH first? Was it up? (alkalosis) Or was it down? (acidosis) If up (alkalosis), was the pCO_2 down (respiratory) or was the HCO_3^- up (metabolic)? If the pH was down (acidosis), was the pCO_2 up (respiratory) or was the HCO_3^- down (metabolic)? Once you know the normals and can identify the direction of the changes, the only problem remaining is not getting yourself confused. Practice will help reinforce the knowledge and minimize the confusion.

For further development on this subject and some additional practice with case studies, read "Understanding Blood Cases" by J. Broughton, M.D., Ohio Medical Products Reprint. It's an excellent article.

POST-TEST

1. List the normal arterial blood gas (ABG) value for pH. __________

2. List the normal ABG value for pCO_2. ___________

3. List the normal ABG value for HCO_3^-. ______________

4. When a patient is in acidosis, his pH will be:
   a higher than normal
   b) lower than normal

5. When a patient is in alkalosis his pH will be:
   a) high
   b) low

6. Mrs. Smith enters the hospital with deep, rapid respirations and an irregular pulse. Her arterial blood gases are:

   pH = 7.05

   pCO_2 = 18

   HCO_3^- = 5

   Mrs. Smith is in a state of:
   a) normal acid-base balance
   b) respiratory acidosis
   c) metabolic acidosis
   d) metabolic alkalosis

7. Mr. Gordon is a 72 yr. old man with chronic obstructive lung disease who enters the hospital with pneumonia. His arterial blood gases are:

   pH = 7.25

   pCO_2 = 60

   HCO_3^- = 36

   Mr. Gordon is in a state of:
   a) respiratory acidosis
   b) respiratory alkalosis
   c) metabolic acidosis
   d) metabolic alkalosis

POST-TEST (cont.)

8. Mrs. Hart, 56, is admitted to the E.R. complaining of light-headedness and tingling in her fingers and toes. She is hyperventilating. Arterial blood gases are:

pH = 7.56

pCO_2 = 14

HCO_3^- = 20

Mrs. Hart is in a state of:
a) respiratory acidosis
b) respiratory alkalosis
c) metabolic acidosis
d) metabolic alkalosis

9. Mr. Lark has chronic indigestion, and frequently takes antacids. On his last regular checkup, his arterial blood gases were:

pH = 7.6

pCO_2 = 54

HCO_3^- = 36

Mr. Lark's values indicate that he is:
a) within normal acid-base limits
b) in respiratory alkalosis
c) in respiratory acidosis
d) in metabolic alkalosis
e) in metabolic acidosis

ANSWERS TO THE POST-TEST

1. 7.4
2. 40mm Hg
3. 24m Eq
4. b
5. a
6. c
7. a
8. b
9. d